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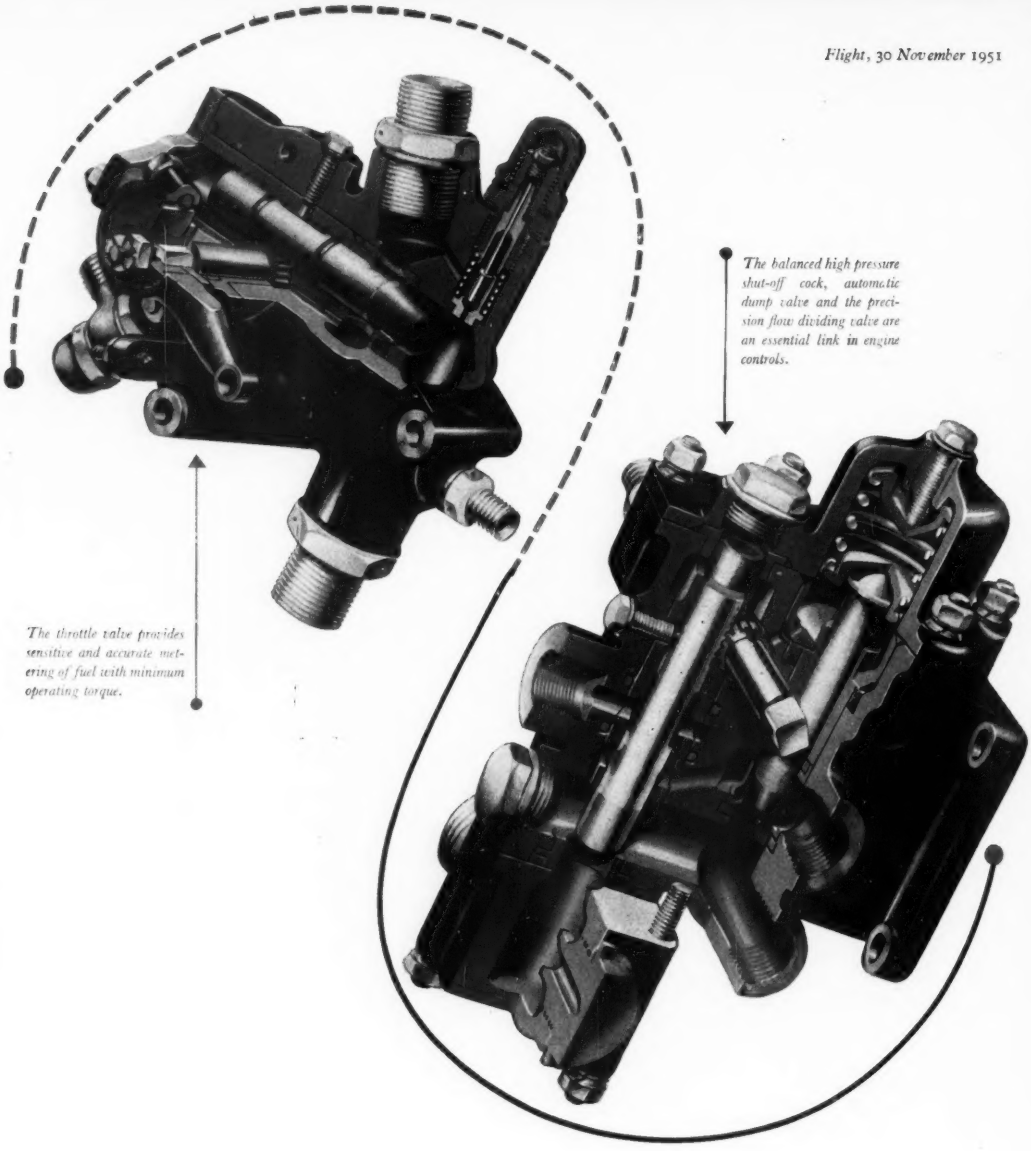

The balanced high pressure shut-off cock, automatic dump valve and the precision flow dividing valve are an essential link in engine controls.

The throttle valve provides sensitive and accurate metering of fuel with minimum operating torque.

LUCAS Fuel Systems

The precision and design of these and similar controls are recognised by their use in gas turbine engines all over the world.

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JOSEPH LUCAS (Gas Turbine Equipment) LTD., BIRMINGHAM & BURNLEY, ENGLAND

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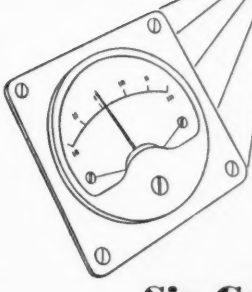
The problem of CABIN TEMPERATURES



With military aircraft now designed for operational altitudes from sea level to 50,000 feet at speeds exceeding 600 m.p.h., the stabilisation of cabin temperature and pressure becomes a vital factor. Apart from the necessity of removing heat from pressure-air fed to the cabin, there is the additional problem of increased cabin temperature due to friction of the boundary layer.

The ability of Godfrey Cold Air Units to meet these demands is proved by their standardisation in a wide range of military aircraft.

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A

An Announcement . . .

DUREX ABRASIVES LTD wish to announce that as from June 14th, 1951, the name of the Company has been changed and is now the MINNESOTA MINING & MANUFACTURING COMPANY LTD.

Identification will be as before, except that the words "Scotch Boy" will be used instead of "Durex" as a prefix to the name of the material, e.g., "Scotch Boy Tapes" instead of "Durex Tapes"

Existing high standards in the quality of the products will be maintained, the change is in name only.

'SCOTCH BOY' *Masking* TAPE

"SCOTCH BOY" Masking Tape is supplied in rolls 72 yds. long and in a variety of widths

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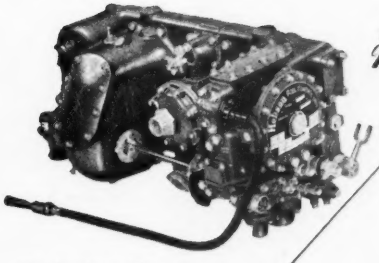
for high performance & reliability

Specialists in the design and manufacture of aircraft carburetter equipment for nearly forty years, H. M. Hobson, Ltd., have established the confidence of the aircraft industry throughout the world.

Built to precision standards and backed by a tradition of quality, Hobson products bear also the stamp of the Company's wide experience and sound knowledge of what is needed to meet individual requirements in the most effective and economical manner.



The above is an illustration of the Hobson Type B.C.15 Injection Carburetter as fitted to Bristol "Centaurus 661" engines.

Britain's Leading Aero-engine Manufacturers continue to specify

Hobson

Master Control

Injection Carburetters

Licensees in U.S.A. and Canada: SIMMONDS AEROCESSORIES, INCORPORATED, TARRYTOWN, NEW YORK, U.S.A.

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MINISTRY OF SUPPLY

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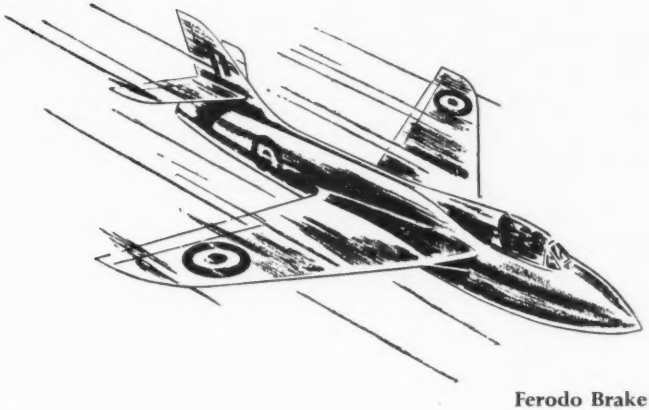
FERODO

CONGRATULATE THE SOPWITH & HAWKER COMPANIES

ON THEIR 40TH ANNIVERSARY

Salute to these pioneers in the field of Aviation whose great achievements have contributed so much to the progress of flying and to aircraft design and performance during the past 40 years.



Ferodo Brake Linings are fitted to the majority of British Aircraft including the P.1067 and the "Sea Hawk".

FERODO LIMITED, CHAPEL-EN-LE-FRITH *A Member of the Turner & Newall Organisation*

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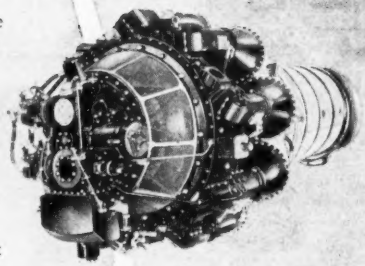
Most of the major castings of the Rolls-Royce "Nene" are in Elektron Magnesium-Zirconium alloy—the most highly developed constructional metal for aircraft. Conspicuous for their services in the aircraft turbine engine field are Elektron ZRE1, with its outstanding creep resistance at 200°C, and Elektron ZSZ, with the highest strength/weight ratio of any cast material. These alloys are the backbone of the jet engine, and to their excellence sixty castings in the "Nene" bear witness.

Illustration by courtesy of Rolls Royce Limited.



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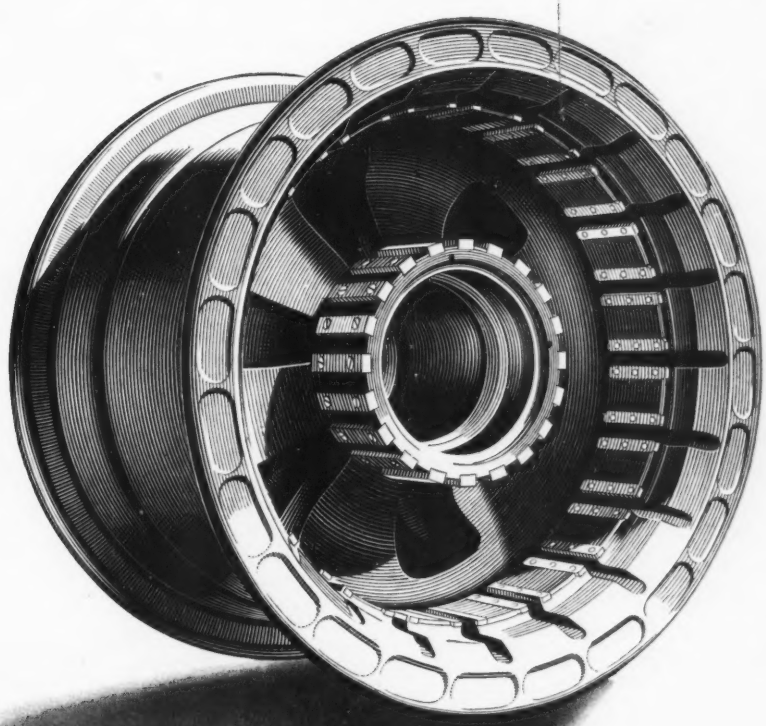
AVIATION EQUIPMENT BY **DUNLOP**



WHEELS

Dunlop wheels are of cast construction in magnesium alloy for land based aircraft and a special aluminium alloy for amphibian services. Main wheels are designed to form a single unit with their brake assemblies. They are the product of one of the largest wheel factories in the world.

DUNLOP RUBBER CO. LTD., (AVIATION DIVISION) FOLESHILL, COVENTRY

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CONGRATULATIONS TO

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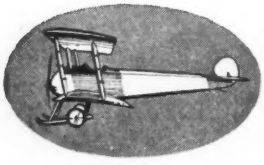
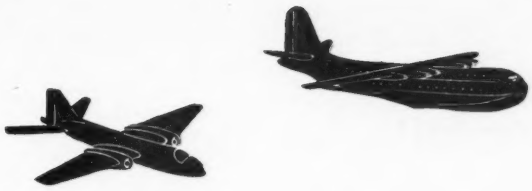
FROM

SHELL-MEX AND B.P. LTD.



who have supplied them with petroleum products since the far off days of the Sopwith Aviation Co.

SHELL AVIATION SERVICE BP



A COMPLETE NORMALAIR SERVICE

With Normalair, supply and service go hand in hand. Our technical staff maintain regular and frequent visits to all operators of Normalair equipment in the United Kingdom.

Our staff are always available for test flights and in the case of overseas customers special visits of considerable duration are constantly being undertaken. Special representatives in Australia, New Zealand, France and elsewhere carry out the Normalair service smoothly and efficiently.

The maintenance of spares and the rapid handling of equipment sent in for repair and overhaul is, we recognise, an essential part of Normalair service. At Yeovil we receive large numbers of civil and service air crews and ground staffs for training in the use and maintenance of Normalair equipment.

We are always ready to send either technical engineers or working parties anywhere to deal with emergencies should they arise.

Normalair service is always alive to the urgencies of civil and service requirements, at home and abroad.

NORMALAIR LTD

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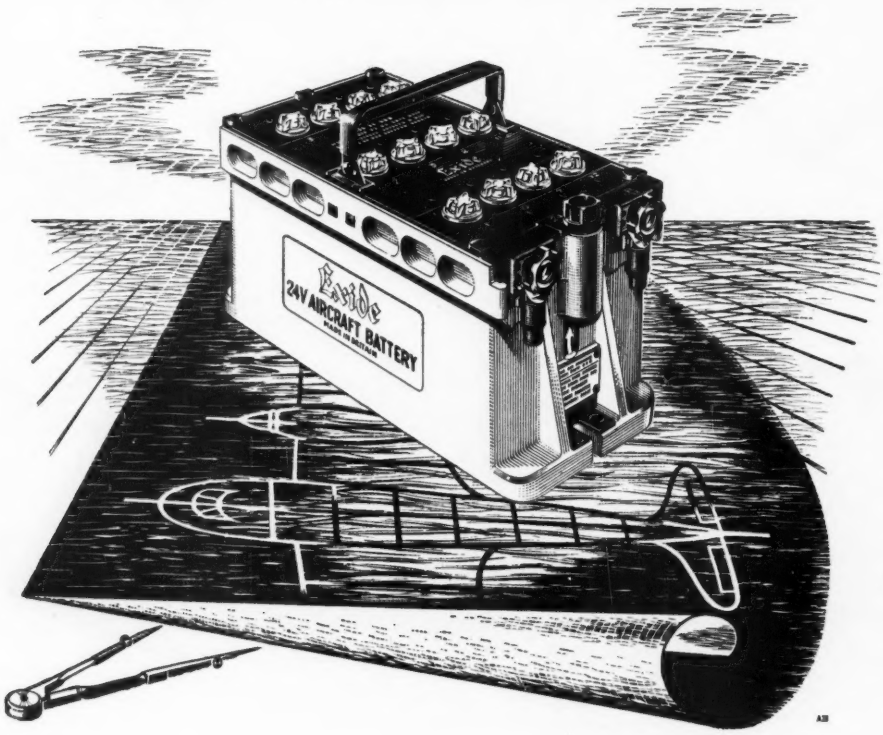
DESIGNERS AND MANUFACTURERS OF AIR CONTROL EQUIPMENT

Current formula for Designers



Figures of minimum battery weight for the given aircraft are modified now—by the advent of the new Exide 24V., lightest British aircraft battery for its voltage and capacity. Weight is money, in civil aircraft. Other things being equal, the lightest battery is the best. For the Exide 24V. it can be claimed that other things are better than equal. In both design and performance, this new battery steps ahead. Lightest—and best in its own right.

Exide AIRCRAFT BATTERY

24 V. 15 Ah. 32½ lb. — 24 V. 25 Ah. 43½ lb.

A PRODUCT OF CHLORIDE BATTERIES LIMITED · EXIDE WORKS · CLIFTON JUNCTION · NEAR MANCHESTER

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Our specialist plant is at your service for the production of "REAMERS OF ALL TYPES" made from the F.B.T. "Speedicut" range of high speed steels, with "Speedicut SATIS" for the exacting demands of high tensile and work-hardening materials.

Extensive stocks of all standard types are available. Your special requirements for all purposes can readily be met.

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FIRTH BROWN TOOLS LTD.

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Congratulations- TO

HAWKERS

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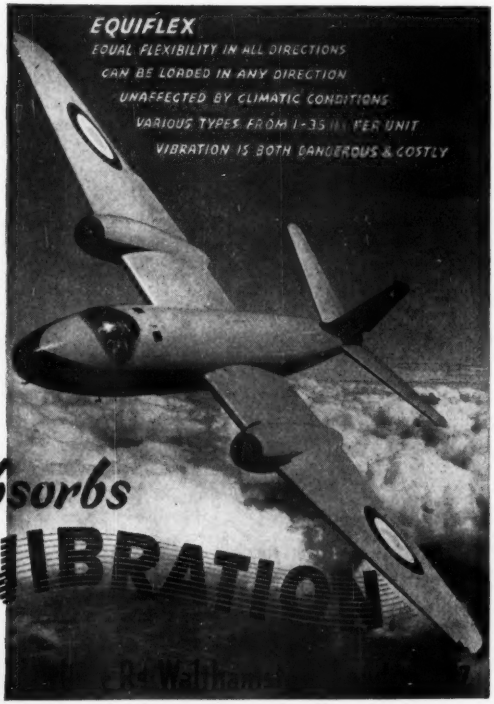
The all-metal Spring Mounting

AS SUPPLIED FOR USE IN THE 'CANBERRA'



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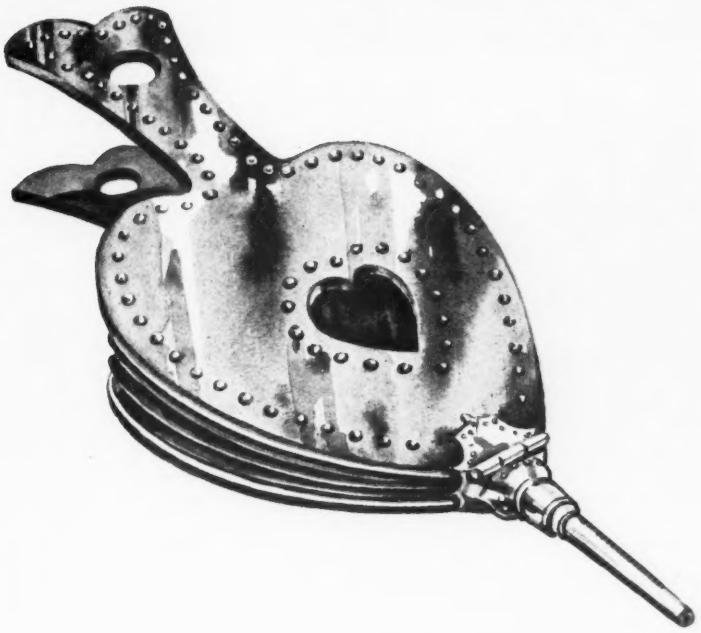
A. WELLS & CO. LTD.



Bellows . . .

Bellows, need we say, are the heart of many important pieces of equipment nowadays. Whilst the history of Teddington bellows is not quite as long as those we have chosen to illustrate, we have been manufacturing them for a considerable time and have gathered together a considerable amount of knowledge and experience. The result is that Teddington bellows, originally produced for our own requirements, are now in widespread demand from a gratifying number of different users; and apart from making them in brass, alumbro and cupro nickel, we also believe that we have more knowledge than most of their manufacture in stainless steel.

Teddington

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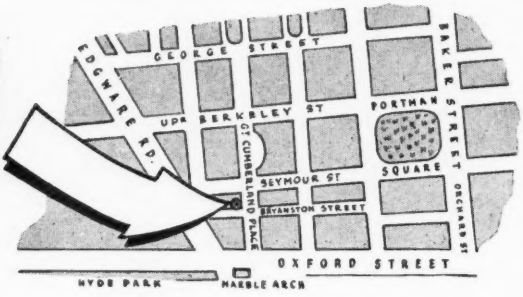
C

ANNOUNCING OUR NEW HEAD OFFICE

Owing to the expansion of our organisation we have found it nece sary to acqu re a larger building for our head office. We therefore inform all our friends in the aircraft industry that from December 3rd our new address will be

15 GT. CUMBERLAND PLACE, LONDON W.1



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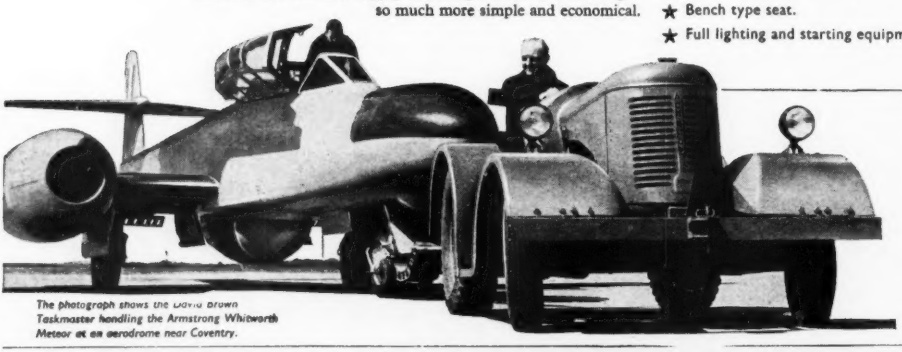
Telephone: **AMBASSADOR 2091** (5 lines) *Cables:* **"AVIATRADE", LONDON**

A Real Tarmac Tug

The David Brown Taskmaster is a real tarmac tug—easy to handle, with all-round driving vision, and turning like a taxi. It hauls all types of aircraft up to 95,000 lbs. all-in weight with either tricycle or conventional undercarriages. Check the features: eight good reasons why, with Taskmasters on the job, ground movement of aircraft, baggage handling and aircraft servicing is so much more simple and economical.

- ★ O.H.V. Engine developing 39 b.h.p.
- ★ 3,500 lbs. drawbar pull.
- ★ Top speed 22 m.p.h.
- ★ Large tyres for greater traction.
- ★ 6-Position towing hitch.
- ★ Exceptional fuel economy.
- ★ Bench type seat.
- ★ Full lighting and starting equipment.



The photograph shows the David Brown Taskmaster handling the Armstrong Whitworth Meteor at an aerodrome near Coventry.

DAVID BROWN

Products of the David Brown Group

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DAVID BROWN TRACTORS LTD., MELTHAM, HUDDERSFIELD, YORKSHIRE

Vision - Initiative - Timing

Congratulations to Hawker Aircraft Ltd. on their 40 years of vision, initiative and timely production of first-class Fighters for the Nation . . . and so forward into the JET AGE with still greater prescience, still more confidence and outstanding achievement in their magnificent P.1067.

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Specialists in One-piece Cockpit Canopies to Hawker Standard

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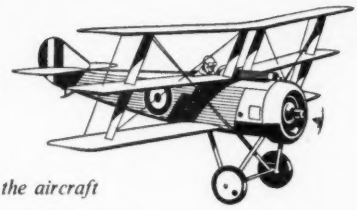
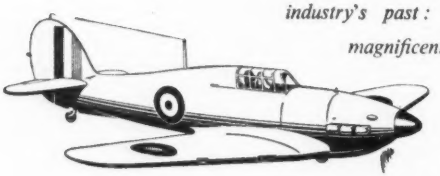


No two names shine brighter from the aircraft industry's past: no aircraft perform more magnificently than those that now bear the Hawker name.



James Booth are proud of the fact that today, as in the earlier years, these famous 'planes make use of their metals.

James Booth & Co. Ltd., pioneers in this country of hard light alloys, manufacturers of 'DURALUMIN' and other well-known light metals

We're still there —of course!

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Single Seat Life Rafts
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FOR AIRCRAFT FITTED WITH EJECTION SEATS
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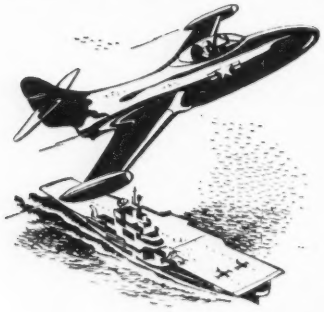
UNITED AIRGRAM

UNITED AIRCRAFT EXPORT CORPORATION

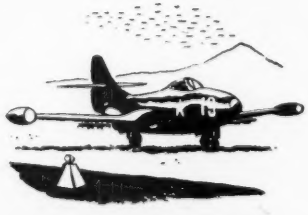
PRATT & WHITNEY J-42 AUTHORIZED 1,000 HOURS BETWEEN OVERHAULS --The Pratt & Whitney J-42 Turbo-Wasp has recently become the first U.S. jet aircraft engine to reach an officially authorized service life of 1,000 hours between major overhauls.



The 1,000 hour overhaul interval was authorized by the U.S. Navy's Bureau of Aeronautics as a result of the exceptional service record of J-42 Turbo-Wasps which power carrier and land based squadrons of Grumman F9F-2 Panthers, flown by Navy and Marine pilots in Korea. In addition to reducing the number of overhauls, exceptional durability of J-42s has enabled the Navy to cut substantially its orders for spare engines and parts.

During the past year J-42 Turbo-Wasps logged more than 100,000 hours in the air in propelling Panther jet fighters a total of 50 million miles. Of this total, more than 20,000 hours and 10 million miles were in combat over Korea. In two years of active flying duty J-42 engines have flown more than 150,000 hours without a single turbine blade failure, and during the same time the overhaul period has risen from 150 to the present 1,000 hours.

The J-42 has performed successfully under the most rugged combat conditions since the second month of the Korean war, including catapult launching of Panthers with maximum loads of bombs and rockets; flying in heavy icing conditions; and resisting the corrosive action of heavy salt spray at sea and choking dust when operating from rough, advance airfields on land. Turbo-Wasp-powered Panthers have performed equally well as high-altitude fighters or low-level attack planes.



Evidence of the J-42's reliability under combat conditions has been its durability in face of major battle damage. Some pilots have even reported that these engines have "swallowed" rocks, three-inch tree trunks, enemy fire and varied debris without serious damage or loss of efficiency to engine output.

NEW MACHINES, METHODS SPEED PRATT & WHITNEY JET ENGINE PRODUCTION -- A program to speed production, increase worker efficiency and improve the quality of finished parts at Pratt & Whitney Aircraft has stimulated the development of several wholly new machine tools and the establishment of major improvements in metal working techniques, it was announced recently. The machines and methods will mean faster and more economical output of new high-powered axial-flow jet engines now being readied for quantity production.

The new machines were worked out by Pratt & Whitney in collaboration with several machinery manufacturers. They possess a high degree of flexibility, currently

desirable because of the wide variety of shapes and sizes of jet engine parts, and to meet requirements of the rapidly changing picture in gas turbine development. Other problems in jet engine production include working with new and tougher materials, the quantity of large-diameter thin-wall sections required, and the need for speeding up production to meet accelerated U.S. Air Force and Navy schedules.

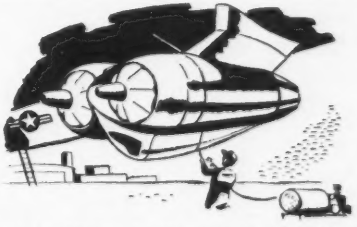
SIKORSKY HELICOPTERS AIRLIFT ENTIRE MARINE UNITS TO KOREAN FRONT LINES --Late in September a fleet of big ten-place HRS Sikorsky helicopters flew an entire company of battle-ready U.S. Marines to an important objective atop a 3,000-foot Korean mountain peak. Thus in a single action -- first of its kind in the world -- helicopters introduced brand-new tactics for warfare over difficult terrain.

The entire operation by helicopter, including the landing of 228 fully-equipped Marines, ammunition, almost nine tons of food, and the laying of telephone wires back to command headquarters, took just four hours. Without helicopters it would have taken at least two days of mountain climbing, and during such a period the enemy might have jeopardized the success of the whole operation. As it was, the Marines were dug in and ready by the time the first enemy shot came over.

Less than a month later the largest helicopter airlift in history, consisting of 12 Sikorsky HRS helicopters, landed a full battalion of about 1,000 combat-equipped U.S. Marines to front line positions in a mountainous sector of East Central Korea. The operation, carried out almost in full view of the enemy, was unopposed, and took only 6¼ hours from start to finish -- some 25 minutes faster than scheduled.

These achievements in actual combat were the rewards for almost four years of training and research by Marine Corps planners, and of even more years of effort by Sikorsky engineers and technicians. But they more firmly than ever established the helicopter as a tactical weapon of first rank.

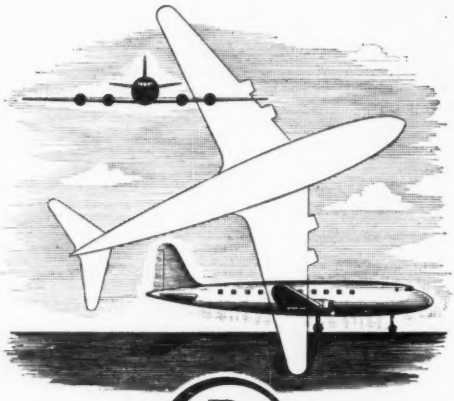
HAMILTON STANDARD HAS HIGH POWERED JET ENGINE STARTER -- A new line of turbine engine starters which substantially reduce the time required for starting turbine power plants has been announced by the Hamilton Standard Division. The first starter developed by the company has passed its pre-production tests and is in limited production.



Considerably lighter than electrical types currently in use, the new starters deliver over 100 horsepower. They will start the highest powered turbine now under consideration in approximately twenty seconds.

The starter, in production for the Air Force's big jet bombers, is operated by compressed air from a ground source or turbine engine. Air is passed through the starter's turbine wheel, which is connected through a gear train to a clutch. When operating at full power, the turbine, which turns up to approximately 45,000 revolutions per minute, delivers its horsepower to the engine's turbine drive. Once a single engine of a bomber has been started, it provides a source of compressed air to be fed through the starter to the next engine.

UNITED AIRCRAFT EXPORT CORPORATION
EAST HARTFORD 8, CONNECTICUT, U.S.A.
European office: 3/5 Warwick House Street, London, SWI, England



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ELECTRIC EQUIPMENT
for
AIRCRAFT

Whatever the type of aircraft, BTH can design and develop the complete electric power system and supply the appropriate equipment, including:—actuators, A.C. and D.C. motors and generators; motor-generating sets with electronic regulators; gas-operated turbo-starters; Mazda lamps, etc. With over fifty-four years' experience of the manufacture of electrical equipment, and extensive manufacturing resources devoted entirely to these products, BTH is in an unrivalled position to fulfil the needs of aircraft industry.

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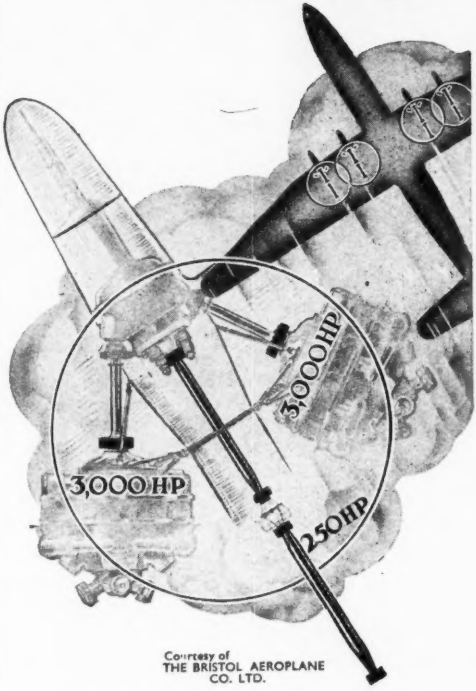

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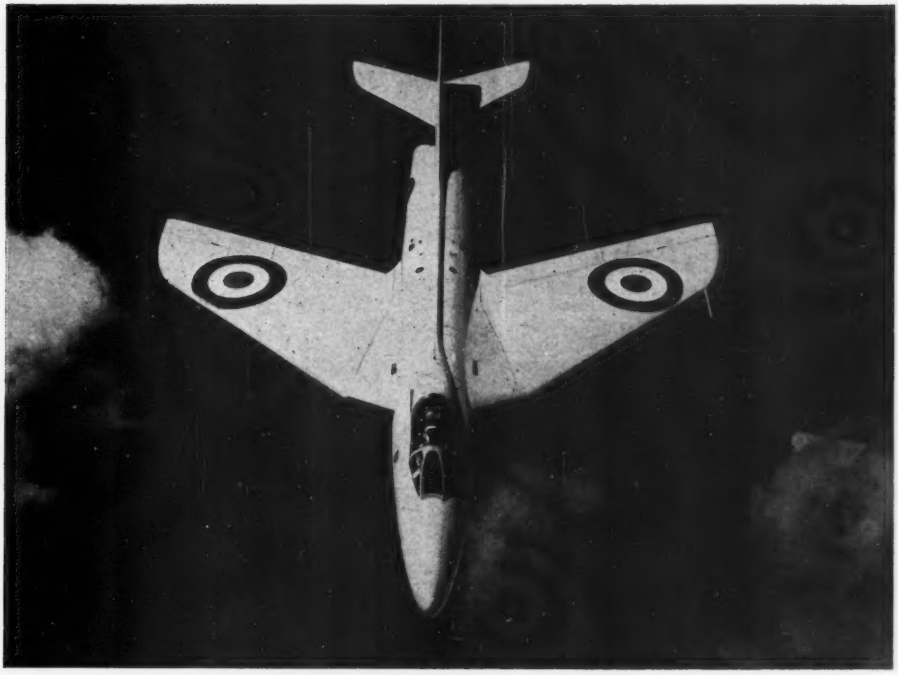

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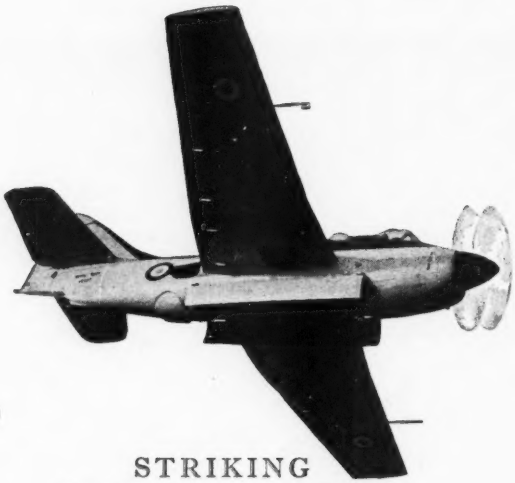

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First Aeronautical Weekly in the World

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Step by Step

NEARLY two years ago the late Government decided to lavish the sum of £30,000 upon selected A.T.C. cadets to enable them to receive powered-flying instruction. The purpose was to encourage a few worthy young pilots and indirectly to aid the clubs at a time when several had already been forced to close down. We referred to the scheme then as "first aid," for it was no more. Although it has been obvious for at least five years that a complete change of official attitude is required to bring about a cure which would permit an active and enthusiastic private-flying movement, such a change has yet to be manifested.

In one of our periodic discussions of this and kindred subjects—in June, 1948—we expressed the opinion that the natural airmindedness of young people was being stifled and that this was bound to have serious repercussions. Today, thanks to drastic action of other kinds and following a period of anxious months, R.A.F. recruiting can be regarded as satisfactory, although that for the aircraft industry is not. Again, a few commercial pilots are still to be found to fill vacancies, but there is no steady flow with the natural grading of experience and seniority. In the R.A.F., it has needed strong—though, let it be added, well-merited—incentives in the way of pay and conditions to attract men back to flying. It is our belief that this state of affairs can to a major extent be blamed upon a mistaken policy of neglect and failure to provide, or even permit, proper outlets for the airmindedness of the younger men and women.

Now, within a month of its election, the present Government has announced a "shot in the arm" to inject new life into private flying. This is to take the form of a financial concession whereby aircraft operation by business firms for their employees' benefit will be chargeable against profits for taxation purposes, as in the case of normal welfare schemes. The Association of British Aero Clubs and Centres, representing 69 British flying organizations, offers its help in a complementary manner by providing a solution to the capital outlay and organization problems. This involves arrangements for members of firms to fly with existing clubs on an economical hourly basis, as explained on page 705.

Announcing the concession, the Minister of Transport and Civil Aviation said, "We are all anxious to bring it (civil flying) within reach of a wider public." At first sight, the new scheme does not seem to go very far towards fulfilling this admirable sentiment. In its effect it is not even wholly new, for a number of aircraft constructors, and other concerns such as Rotax and London Transport, have for some time past offered their employees cheap flying. However, it is one more step in the right direction; others must now be taken, and taken quickly, for in aviation as in other national affairs the results of many years of official indifference and perversity have to be made good.

An Unsurpassed Tradition

SHOULD anyone disagree with Byron's dictum that the best prophet of the future is the past, we would commend to him the principal feature of this issue, telling (we believe for the first time in print) the story of the Sopwith company—its rise, its achievements in the war of 1914, and its demise in the lean years. And if he reads on, he will concur that there is no prouder story in the annals of the industry, unless it is that of Hawker, under which name the original company was reanimated in 1920.

The way back was a hard one; but tenacity had its reward in the phenomenal success of the Hart and Fury during the nineteen-thirties, and the legendary achievements of the Hurricane, Typhoon and Tempest in the second world struggle.

To-day Hawkers make their bid for pre-eminence in the transonic fighter field with the P.1067, ordered off the drawing-board in the knowledge that behind it lies an incomparable fighter tradition, founded by the Tabloid, advanced by the Pup, 1½-Strutter, Triplane, Camel, Dolphin and Snipe, and carried to new glory by the Hurricane and its successors. It is a tradition of which the industry—indeed, the nation—may be as proud as Hawkers themselves, and in presenting our story we offer our sincere congratulations.

H.M.S. "EAGLE"

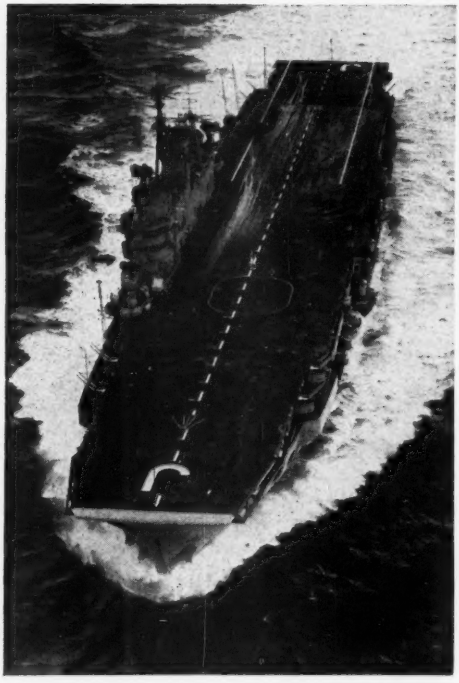
Impressions Aboard the Royal Navy's Latest and Largest Aircraft Carrier

GLASGOW, the journey to Greenock, and Greenock itself, seen with eyes that have closed only intermittently during a "sleeper" journey from London, did not present particularly engaging prospects on a bleak and drizzly November morning. But out in the Clyde was our objective, and even though the bold outlines of Ben Bowie and Rosneath were blurred by the gauzy tulle of decaying cloud and driving rain-squalls, nothing could diminish the pale-grey majesty of the ship anchored off Tail of the Bank. Huge and foursquare she lay in the iron-green water—H.M.S. *Eagle*, the largest aircraft carrier this country has ever had, and the most modern ship of her kind in the world.

The twenty-first ship of her name in the annals of the Royal Navy, *Eagle* is sister ship to the new *Ark Royal*. Each has a standard displacement of 36,800 tons, and a full-load displacement of 45,000 tons. Four sets of steam turbines produce 150,000 s.h.p. to give the ships a deep-load speed of 31 knots, whilst—a new departure for carriers—twin balanced-rudders permit high-speed manœuvrability of a kind eclipsed, perhaps, only by destroyers.

The hangarage capacity is enormous; so great, indeed, that although the normal practice in quoting a carrier's aircraft complement is to include deck-park capacity, we can almost believe that the 100 aircraft accredited to *Eagle* could all be accommodated in the two-storey hangars. Someone had worked out that 263 double-deck buses could be stowed in the hangars; and we have calculated that, were 263 London buses placed end to end, they would stretch just over a mile and a quarter. Whilst on the subject of figures, it may be noted that the overall length of the ship is 803ft 9in, and the beam is 112ft 9in; bare facts that come to life when put in terms that the flight deck has an area of over two acres.

As Captain Guy Willoughby, R.N., took his new ship to sea, we went on a breathless tour of just a few of the vessel's 1,310 compartments. *Eagle* has ten decks, and damage-control has decreed that the great majority of door coamings should be high; our tour was not, perhaps, a steeplechase, but we were glad to sit down for lunch. Damage-control measures are in advance of those in anything else afloat: all the war experience gained in British ships, and those of our allies and our then-enemies has been drawn upon to give the new carrier a degree of invulnerability never before approached. In this context, Captain Willoughby said that the experts had told him that if, nevertheless, the ship became flooded up to the level of the hangar deck, "it might be a bit difficult to operate aircraft."



During the forenoon, our tour was confined to the domestic departments of the ship. In the bakery, with its flour-sifting, pie-making, and dough-dividing machines, 5,000 lb of bread per day can be produced and, be it said, the quality of that bread is much higher than that which can be obtained ashore. The laundry is also completely mechanized, and each rating is allowed 10 lb dry weight of wash per week, for which he is charged 9d; a civilian laundry would charge approximately 7s. 6d. for the same job. All the living spaces and the great majority of the working spaces in *Eagle* are fully air-conditioned, and equable temperatures and humidities should be assured irrespective of whether the ship is operating in arctic or tropical waters. Again, most living and working spaces are illuminated by fluorescent lamps, the normal "daylight" versions of which are complemented in various compartments—such, for example, as the aircrew briefing room—by red lights (also fluorescent) so as not to destroy night-vision adaptation.

A radical departure for H.M. ships, *Eagle* has the innovation of a centralized messing system, whereby Chiefs, P.O.s and ratings obtain their meals in two large dining-halls. By this means, the mess decks are virtually freed for use as recreational and sleeping spaces. Every man has a kit-locker in which is incorporated a personal locker, and by an ingenious key-issue system, privacy is assured. Adjacent to the mess decks are a great many wash-places, all with tiled decks, stainless-steel basins, individual mirrors (each with a light) and plastic-curtained showers. In virtually every

"Flight" photograph
The most noticeable features of the huge "island" are radar arrays. "Eagle" has probably more radar equipment than any other ship afloat.

respect, the man who serves in *Eagle*, be he ordinary seaman, artificer, or an officer, is provided with living conditions setting an entirely new standard for ships of war.

As we had clambered up and down and round about from one part of the ship to another, we had caught glimpses of the world outside. The wind was building up to whole-gale force and sweeping the clouds before it so that the white horses galloping over the Firth sparkled and glittered in the sun. We were down in the wardroom, recuperating from our labours with a reinforced tonic preparatory to having lunch, when it was announced over the ship's broadcast system that full helm high-speed turns were about to be made. Apart from a scarcely noticeable low-frequency vibration, *Eagle* was quite steady. If she was, in fact, pitching and rolling, it was through such small angles that, in the wardroom at least, it was unnoticeable. However, we thought such a manœuvre would be well worth watching, so we went up to the quarter deck.

We shall never forget it—it was magnificent. The ship was ploughing through the water at 28 or 30 knots, and when 36,800 tons of sea water gets shouldered aside at something over 30 m.p.h., even if the intrusive body has the most exquisitely fine lines, the resulting commotion (especially when seen from as low a height as 25ft) is a sight not quickly to be forgotten. The gale itself was tearing spume from the glittering waves and this, added to the ship's speed through the water, made the atmosphere on each quarter and astern an opalescent mist shot through with the pulsating lambence of great rainbow arcs. Then, as full helm to port was applied, the ship heeled outwards, and started to sweep round in what the curving wake made evident was an astonishingly small turning circle. The boiling rage of water close up under the stern made a hissing roar so loud that one had to shout into one's neighbour's ear to make oneself heard.

Somewhat awed by the manifestation of such elemental power at such close quarters, we went below to lunch.

"Flight" photograph

Captain Guy Willoughby, R.N., captain of H.M.S. "Eagle," and Commander P. J. Hill-Norton, R.N., the executive officer of the ship.

Throughout our meal *Eagle* continued to make tight high-speed turns, first to port and then to starboard, but although fiddles were fitted to the tables, they were not needed; certainly, the ship heeled 10, perhaps 12, degrees, but that was all. She was almost incredibly steady for the sea and wind and speed conditions existing.

After lunch, we were able to turn our attention to the operational side of the ship. In order to go up to the island, we travelled up to the flight deck on the after lift. Then came the job of walking, or rather staggering and lurching forward against the 60-knot wind over the deck. Having at last won the sanctuary of the island, we went into the aircraft-control room, from which centre the whole organization of aircraft movement in the hangars and on deck is governed. Then we went up to the compass-platform which, to our untutored eye, looked much the same as that of other carriers we have visited. There were, however, comparatively few voice pipes because virtually all intercommunication between departments of the ship is conducted by means of radio and telephone. Thus, isolation integrity between compartments from fire, gas and atomic radiation is preserved. The telephone system aboard the ship is entirely automatic: one picks up the receiver and dials the appropriate number, just as one does ashore.

One of the entirely new operational features of the ship is a combined double-deck operations room and aircraft-direction room. A most comprehensive array of plotting tables and wall plotting-boards, together with P.P.Is. of various kinds, is arranged on the "ground floor," and above this is a gallery, the well of which is enclosed by Perspex screens. Thus, observers in the gallery can see (and hear) everything that goes on below, whilst not encroaching. Another new feature of this arrangement is the provision of viewing pedestals in the gallery, whereby, through an optical system, a magnified plan view of individual plotting tables underneath is given.

Not until the ship was back at anchor did we have comfortable opportunity to have much of a look at the flight deck. There is nothing seemingly new about the arrester-wire arrangements, except in terms of numbers, for there are, in fact, 16 wires. In the case of the crash barriers, however, there is a departure from standard practice in that, as well as having more barriers (six), they vary in type; there is one barrier for jet aircraft, there are three for single-engined airscrew-driven types, and a further two for twin-engined aircraft. At the other end of the scale—and the flight deck—there are two catapults, each with an entirely new system of motorized centring. That is to say, instead of an aircraft having to be manhandled into its precise position on the catapult, it is merely taxied forward to an approximately right position, whereupon the centralizing gear takes over and "spots" the aircraft quickly and accurately. So far as we

"Flight" photograph

The view of the flight deck from Flying Control is unobstructed. Sixteen arrester wires and six barriers of three individual types are fitted.

H.M.S. "EAGLE" . . .

were able to judge from a purely external examination of the centralizing system, it would appear that the aircraft is taxied forward until the main wheels come to rest on sets of rollers positioned athwartships at the rear end of the catapult trolley-slot. The rollers must be powered so as to move the aircraft bodily sideways to the correct position. Also to be seen were rubber "mats" rather like those in roads for traffic-light actuation. Ahead of the mats were hinged flaps in the deck and these we assume to be automatic chocks.

In common with the existing fleet carriers, *Eagle's* main armament comprises 16 4.5in guns, but uncommonly, these are dual-purpose high-angle/low-angle units, mounted in pairs in flat-topped deck-level barbettes, there being two pairs of guns per battery, and one battery on each bow and each quarter. The fire-direction system for all the guns incorporates the most recent developments and is particularly designed to cope with high-speed targets. Radar control is also provided so that targets may be engaged at night or in conditions of poor visibility and with an accuracy corresponding to that achieved in visual fire. As part of the modern trend, the ammunition and charge hoisting arrangements are entirely new and fully automatic, and we were told that this development frees seven men from each pair of guns. In addition to the main armament, the ship also has 57 40-mm Bofors guns in multiple and single turrets. These are controlled by special radar directors, which are not only extremely accurate, but give an astonishingly high percentage of hits at their effective range.

In conclusion, it remains only to be said that *Eagle* will start embarking her squadrons in the spring. The first of them will be No. 800 Squadron which, as we stated in the October 19th issue of *Flight*, is the first operational squadron in the Navy to be equipped with jet aircraft—Attackers. No. 800 is a fine squadron. *Eagle* is a great ship. We feel sure that both will achieve the highest standards of Naval tradition.

C.B.B-W.

"Flight" photograph

Commander N. K. Cambell, M.B.E., D.S.C., R.N., the Commander (Air).

Wind-rode, and lying to her starboard anchor off Tail of the Bank in the River Clyde, H.M.S. "Eagle" presented a stirring sight despite a livid sky and watery sun.

"Flight" photograph

A.S.V. ANNIVERSARY

TEN years ago today, November 30th, the first "kill" of a U-boat detected by airborne radar was recorded, when a Whitley of No. 502 (Ulster) Squadron—operating from Chivenor, Devon, and commanded by the late F/O. R. G. Holdsworth—sunk U.206 250 miles west of St. Nazaire.

The apparatus used was the Mk 1 A.S.V. Now, for the first time, the Air Ministry has made public the story of some of the early research work on airborne ship-detecting radar. It began in 1935, when experiments had already shown that airborne equipment was essential if the possibilities of radar detection were to be exploited to the full. Research was started by Dr. E. G. Bowen (now head of the Australian Government Radio Physics laboratory at Sydney) and a small team of co-workers. Their problem was to produce, on a scale to fit inside an aircraft, radar equipment that would provide results comparable with those of the existing ground installations—which weighed tons and used aerials up to 240ft high.

By December, 1936, a small receiver was completed and fitted in a Heyford and, used in conjunction with a ground transmitter, it gave the first proof that echoes from one aircraft could be received in another; early in the following year a transmitter was also installed in the Heyford. The emphasis at this time was still on producing equipment to detect other aircraft, but during test flights around Harwich it was noticed that echoes were received from the coastline and harbour installations.

In July, 1937, a more advanced set was fitted into an Anson and on an early trial flight echoes were obtained from a 2,000-ton freighter at a distance of five miles. Elated by this result, Dr. Bowen decided to explore further the employment of radar for detecting ships at sea, and it was arranged that trials should be made, in strict secrecy, during Home Fleet and Coastal Command exercises in September. A preliminary flight was made on the eve of the exercise, during which H.M. Ships *Rodney*, *Southampton* and *Courageous*, steaming through the Channel to the exercise area, were intercepted at a range of four miles.

Overwhelming proof of success was provided next day, September 4th. Soon after the start of the exercise the weather steadily deteriorated and all Coastal Command aircraft were recalled before any Fleet sightings had been reported. The Anson, which was not fitted with radio and did not receive the recall, continued with its private reconnaissance. Flying in very poor visibility, it picked up the *Courageous*, *Southampton* and attendant destroyers by radar at a range of about nine miles. As it closed to within visual range to confirm the identity of the warships the vessels thought that an official "attack" was imminent, and *Courageous* dispatched her fighters to intercept. These, too, appeared on the Anson's radar screen as they took off. Aided by radar responses from the coastline, the Anson made an accurate landfall despite very bad weather, and that evening a somewhat surprised Duty Air Staff officer, who believed that all flying had been cancelled, received a telephone message accurately stating the position of the Fleet.

Experiments with the Anson continued at Martlesham Heath, using many different aerial layouts and various modifications. F/L. Kenneth Naish (then a sergeant), who flew the aircraft on the earlier tests, continued to act as pilot, with Dr. Bowen as radar observer. One effect of the aerials was to increase the stalling speed by some 20 m.p.h., and the normally docile Anson became a machine requiring very careful handling. F/L. Naish, who has recently rejoined the R.A.F. in the Fighter Control Branch, recalls that one aerial was installed between the wheels, making it impossible to retract the undercarriage, and that the general impression was of a flying Christmas tree.

SECURITY-MINDED !

UNUSUAL initiative was shown by a motorist who, passing the Gloster airfield at Moreton Valence last Sunday, saw (it is reported) a man and woman taking photographs. A pilot also wirelessed a warning to the control tower. Shortly afterwards, police stopped a car at Stonehouse, three miles away, and took possession of a camera carried by its occupants, said to be an Italian man and a German woman.

FROM ALL QUARTERS

Two More Comets for Canada

ALTHOUGH no official announcement or confirmation is as yet forthcoming from the manufacturers, it is understood from Canada that the Canadian Government is now completing negotiations for the purchase of two de Havilland Comets. The purposes for which the aircraft are being acquired are not disclosed, although one duty is believed to be in connection with high-altitude interception exercises for the R.C.A.F. It is possible, also, that while remaining the property of the Government and being available for whatever national purposes may be in mind, the Comets may also be operated commercially by Trans-Canada Airlines, or perhaps by Canadian Pacific Airlines, together with the two other Comets which this company has already ordered.

Minister of Supply Visits Kingston

PAYING his first visit to an aircraft factory since he took office, Mr. Duncan Sandys, the Minister of Supply, spent some instructive hours with Hawker Aircraft, Ltd., at Kingston on Wednesday, November 21st. He was conducted round the factory by Mr. A. Neville Spriggs, director and general manager. Mr. Sandys told representatives of the management, design staff and workers that "aircraft production is one of the most essential elements of our national defence, and secure defence is the indispensable foundation for the establishment of a stable and lasting peace. The sooner we can complete our defence programme the sooner we shall be able to turn our attention to the production of more consumer goods."

Discussing the problem of increased production, particularly of the P.1067—the principal object of his visit—Mr. Sandys said that because there was insufficient labour available at Kingston, arrangements had been made for Hawkers to open the big new Squires Gate (Blackpool) factory. He added that the Hawker Group factories at Kingston would be very fully occupied with defence production for the foreseeable future.

Those Russian Nenes

REVIVED in the House of Commons on Wednesday of last week, the old subject of the Nene turbojets supplied to Russia in 1946-47 caused a short but violent storm.

It began when Mr. William Shepherd (Cons., Cheadle) asked the Under-Secretary of State for Air what opinion he had formed, as a result of examining the engines of Mig-15 fighters, on the technical benefits which the Russians had derived from their purchase of Nene engines.

Mr. Nigel Birch replied that examination of a captured Mig-15 had shown the engine to be a copy of the Nene, and that some of these engines had been developed to give increased thrust. "It is thus reasonable to suppose," he added, "that the Russians have derived substantial benefit from the sale to them of these Nene engines."

Mr. Shepherd : "Is it not clear from the answer just given that the sale of these engines was not merely an act of foolishness but struck a real blow against the free world?"

Mr. Birch : "I think it was certainly unfortunate."

Mr. Ernest Shinwell, the former Minister of Defence, then rose from the Opposition front bench to ask : "In view of the disclosure by the Minister about the benefits alleged to have been derived from the sale of the Nene engines, will the Minister disclose the whole of the facts which have now been made available to the air experts?"

Mr. Birch asked what facts he had in mind, and to this Mr. Shinwell retorted, "If he will make inquiries, and if he feels fit to make the necessary disclosure, he will discover his statement to be a travesty of the facts."

Amid loud cries of "Withdraw!" directed at Mr. Shinwell from the Conservative benches, Mr. Birch said, "He will be aware that this answer has been carefully vetted and prepared by the Ministry." Mr. Shinwell rose again and said, "Is he [Mr. Birch] or the Minister of Defence [Mr. Churchill] aware that the statement made to me by our Intelligence experts is contrary to the statement made by the Minister?"

Mr. Birch replied that his answer was based on information supplied by the intelligence experts.

Mr. Arthur Woodburn (Lab., Stirling and Clackmannan) asked whether the Minister had communicated with the Ministry of Supply, which was the department responsible, and whether he was aware that the experts of the Ministry of Supply "gave us information that it was quite impossible that the Russians could learn anything which they did not already know" ("Oh, Oh! from the Conservative benches.)

The Speaker then intervened and stopped further questions.

BADGE FOR S.U.A.S.: As reported on page 706, A. Cdre. R. Coats, A.O.C. No. 62 Group, Home Command, recently visited Southampton University to present a new badge to the University's Air Squadron. Sir Robert Wood, the Principal, is seen receiving it.

War Correspondent Honoured By U.S.A.F.

AT an informal ceremony held recently at the office of the United States Air Attaché in London, the Attaché (Brigadier-General Jack W. Wood, U.S.A.F.) presented to Mr. William Courtenay, O.B.E., M.M., a scroll recording his honorary membership in the Far East Air Force of the U.S.A.F. The award had been conferred by Lt-Gen. George A. Stratemeyer, the Commanding General of F.E.A.F., earlier this year.

This honorary membership of a fighting force—which entitles the holder to wear F.E.A.F. sleeve insignia on his war correspondent's uniform—was conferred in recognition of Mr. Courtenay's coverage of the Korean War over the past two years, during which he has flown on numerous sorties as war correspondent of Kemsley Newspapers. In 1949 Mr. Courtenay received similar recognition from the U.S. 5th Air Force for his four years' coverage of the Pacific War.

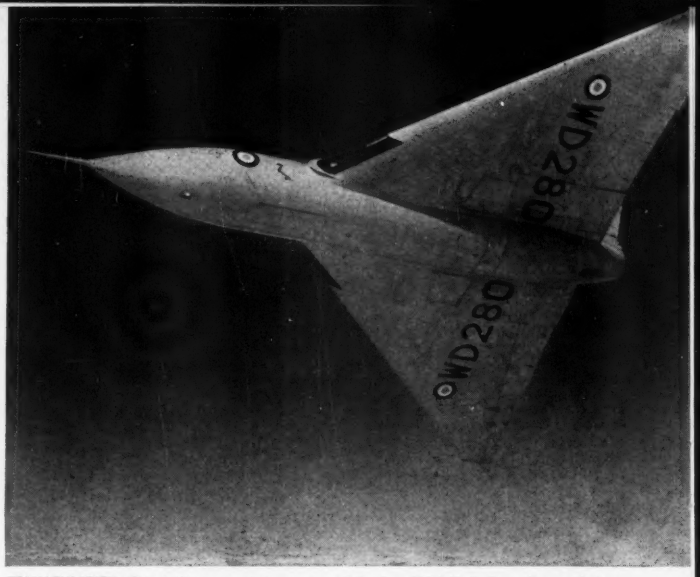
He has lately returned from a tour of training bases in America, during which he delivered 120 lectures on the Korean War, illustrated with his own colour films.

New Canadian Air Attaché in Paris

AN announcement from R.C.A.F. headquarters in Ottawa says that G/C. F. A. Sampson, O.B.E., C.D., has been appointed Canadian Air Attaché in Paris. He succeeds G/C. F. C. Carling-Kelly, A.F.C., C.D. who has been selected to attend the new N.A.T.O. Defence College in Paris. G/C. Sampson, who returned to Ottawa this year following a tour of duty in Argentina as Air Attaché, is now in Paris to take up his new duties. Joining the R.C.A.F. in 1927, he flew on aerial photo-survey operations and on test and development work, and from 1937 to 1939 served with the R.A.F. on exchange duties. During the war he commanded a number of heavy bomber squadrons in Britain. In 1945 he served in senior staff positions in the U.K. and in Germany. Before going to Argentina he served as Chief Staff Officer at North West Air Command, Edmonton.

G/C. Sampson.

HERE AND THERE



TRIANGULARITY: This striking new air-to-air view of the Avro 707A (Rolls-Royce Derwent) shows to advantage the wing-root intakes that clearly distinguish it from the less-speedy 707B, which has a single intake behind the cockpit.

Norwegian C.A.S.

FORMERLY Norwegian Air Attaché in London, Col. Tufte Johnsen has been appointed Chief of Air Staff in the Norwegian Air Force. He is only 36.

Family Affair

SO many people living in Boston, Mass., are of Scottish descent, that a direct Boston-Prestwick air service, independent of existing transatlantic services, is in demand. That such facilities might eventually be provided by B.O.A.C. was hinted last week by Sir Miles Thomas, the Corporation's chairman, when he passed through Prestwick on his way back from America.

Filton Nocturne

THE Bristol Brabazon recently made its first night flight, in the hands of chief test pilot A. J. Pegg. The object was to test landing and take-off performance after dark, and half-way throught the 50-minute trip the big aircraft was put down on the Filton runway and then taken off again. Normal runway lighting was used, and the results were reported as "entirely satisfactory."

U.S. Baby Turbojet

FAIRCHILD engine division, says *American Aviation*, has gone into production with the J-44 turbojet. Of 1,000 lb thrust, weighing 325 lb and measuring 72in long by 22in diameter, it will probably be used for guided missiles, target aircraft and assisted take-off. From the same source comes news that the 125 h.p. aircraft diesel engine developed by Diesel Power, Inc., has made a successful first test flight in a standard Taylorcraft.

Postponed

A CLASSIC aviation social event, the Contractor's Dinner—at which the officers of the A. and A.E.E., Boscombe Down, entertain members of the industry—has been postponed from December 7th to January 11th.

Beating-up the Bridge

A LIGHT aircraft—unidentified as these words are written—was flown under the Tower Bridge last Sunday morning. The incident recalls a similar one in September 1931, when Maj. Christopher Draper, D.F.C.—the "Mad Major"—flew a Puss Moth twice under the Tower Bridge and once under Westminster Bridge; later, at the Mansion House, he was bound over.

A.R.B. Evacuation

THE Egyptian troubles have caused the removal of the Air Registration Board's Middle East office from Cairo to Nicosia, Cyprus.

Turn it Up!

COPIES of the index to the January-June, 1951, volume of *Flight* are available at 1s. (1s 1½d by post), or at 6s (6s 5d) with binding case, from Iliffe and Sons, Ltd., Dorset House, Stamford Street, London, S.E.1.

Sir William Stampe

IT is with regret that we record the death of Sir William Stampe, who, at 69, was one of this country's oldest private owners of aircraft. His Auster crashed near Colyton, Devon, on November 20th, and both Sir William and an R.A.F. officer, who was flying with him, lost their lives.

PAKISTAN RECORD: In the picture on the left is S/L. Zafar Chaudhry of the R.P.A.F., who recently flew a Hawker Fury over 1,830 miles non-stop in 8 hr 25 min. Most of the flight was over the North-west Frontier and the Punjab.

TRANSATLANTIC TEAMWORK: Sir George Nelson, English Electric chairman, confers with Mr. C. C. Pearson (centre), president of Glenn Martin, who are building a night intruder version of the Canberra; on the right is Mr. H. G. Nelson, deputy managing director of the British company. It has recently been confirmed that U.S.A.F. Canberras will have American-built Sapphires.

Collaboration that has made History

THE CLOSE ASSOCIATION of many years between Hawker Aircraft and Rolls-Royce has produced famous aeroplanes such as the Kestrel powered Hart and Fury series and the Merlin powered Hurricane of Battle of Britain renown.

In the jet era of today
this close collaboration
still continues.

E

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HERE AND THERE . . .

Non-Starter

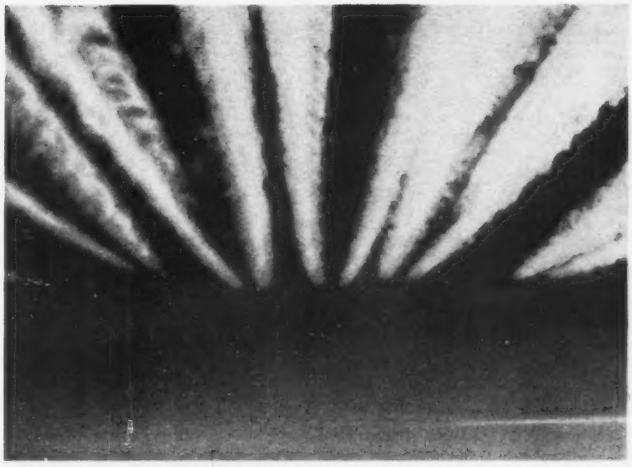
STEWARDS of the Jockey Club have denied rumours that the Rowley Mile racecourse at Newmarket is to be made into an airfield for the U.S.A.F.

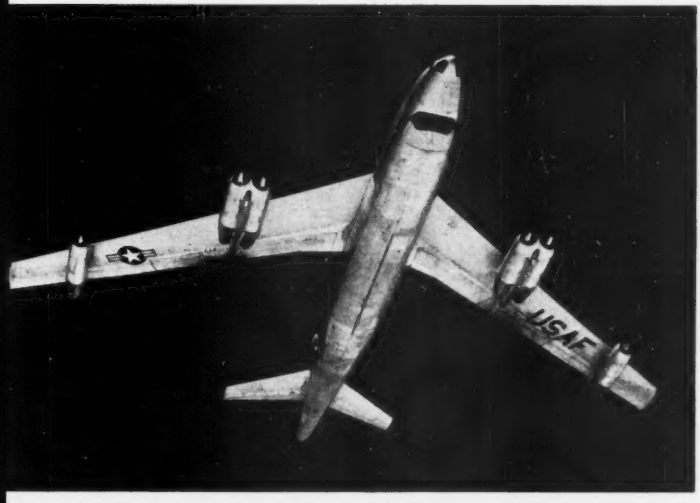
Another Chrysler Contract

THE latest big sub-contract—"running into millions of dollars"—received by the Chrysler Corporation is for airscrews for naval aircraft. Additions to the company's San Leandro plant will include two 400-ton presses for hot-forming blades.

Jobs Going

ACCORDING to a report from California, the aircraft plants on America's Pacific coast are experiencing ever-increasing difficulty in obtaining workers for their expanded production. Douglas Aircraft are sending out all their trucks with big notices reading "Douglas is a good place to work—ask the driver," and drivers and other employees are encouraged to distribute "recruiting" leaflets.





MAKING THEIR MARK: A striking contrail impression of Meteor 4s of No. 723 Sqn. of the Danish Air Force, flying over Denmark at 38,000ft. The photograph was taken from the front seat of a Danish Meteor 7 trainer.

Prone-pilotage Postscript

LAST week we published a photograph of the Reid and Sigrist aircraft developed for prone-piloting research. It is now learned that the name Bobsleigh, originally applied to the design, has been abandoned as being inappropriate.

New Use for Hythe

THE Admiralty has purchased—at an undisclosed price—the B.O.A.C. flying-boat base at Hythe, on Southampton Water. The base, which has been out of use since the Corporation's flying-boat operations ceased a year ago, will be employed for the fitting-out of corvettes, M.T.B.s, and other small naval craft.

Remounted

FROM France comes the news that the famous Patrouille d'Etampes squadron, whose low-altitude aerobatics with Stampe biplanes have been an outstanding feature of air displays in this country and on the Continent, is to have a fleet of Cyclope IIIs, powered by Turbomeca turbojets. Whether they will replace the biplanes, or be flown as a separate formation, is not yet clear.

Mid-air Initiative

A GALLANT action that has more than once been simulated in flying films was actually achieved at Fort Benning, Georgia, recently, during a demonstration drop by 90 paratroops. When one soldier's parachute failed to open properly, another man swung towards him and grabbed its lines, managing to retain his hold until both landed safely. For some reason, possibly panic, the man in trouble had failed to use his reserve parachute.

SHARK'S MOUTH: Most noticeable in the view—secured at 30,000ft over Kansas—of a Boeing B-47 is the new fairing over the radar housing. In the lower photograph, taken in the makers' plant at Wichita, B-47 wings make an effective pattern; in the background, the complete aircraft are taking shape.

THE GIANT HELICOPTER

A Lecture of More than Ordinary Interest—Part I

BY the drawings and models of projects exhibited on their stand at Farnborough, plus information which has appeared from time to time in this journal, it has been made evident that Westland Aircraft, Ltd., have considerably more than a casual interest in bigger and better helicopters. In his lecture, *The Giant Helicopter*, delivered to the Helicopter Association of Great Britain, last Friday, November 23rd, Mr. O. L. L. Fitzwilliams, B.A., made it quite clear of just how much bigger and better rotary-wing aircraft at least one person down at Yeovil is thinking.

Mr. Fitzwilliams started by saying that his paper described a hypothetical family of giant helicopters in which certain design and operational trends were taken to what seemed to be their logical conclusions, and indicated, he believed, even if only in broad outline, the sort and order of achievement which might be within reach in the reasonably near future.

He had assumed that turbojet engines could be operated at the tips of the rotor blades. This assumption represented essentially a solution of the three main problems facing the designer of the large helicopter, viz., the control of transmission weight, the control of blade weight, and the achievement of an acceptable fuel consumption. No other type of power-plant seemed to offer so effective a solution to these problems, but there were alternatives which departed from this optimum only by relatively small margins, and the validity of the picture did not absolutely depend on the correctness of the main assumption.

Accepting the principle of jet-drive, the designer was still faced by the excessive blade weight which was generally required to ensure a reasonable coning angle in large rotors. To minimise this weight, the designer would naturally wish to concentrate as much of it as possible at the blade tip where it had the maximum effect as a means of controlling the coning angle. However, for large rotors of sufficiently high disc loading, it could be shown that the non-structural weights concentrated at the blade tips might be of the same order of magnitude as the weight of the entire power installation of the helicopter. Thus, the problem of blade weight in large rotors, which arose from their slow rotation, also suggested its own solution, since the centrifugal acceleration at the blade tips might no longer be so formidable as to prevent the mounting of turbojet engines in place of the tip weights. The turbojet also offered a direct solution to the problem of acceptable fuel consumption because, at least for subsonic tip speeds, it was undoubtedly the most efficient form of jet-drive.

The lecturer said that he had not attempted a generalised theoretical presentation, but the somewhat arbitrary examples given were based on data applicable to any single-rotor helicopter, and he had obtained what seemed to him to be a realistic picture in the following rather simple manner:

When the forward speed and rotor tip speed had been decided, it was convenient as the next step to determine the maximum blade loading consistent with freedom from stalling of the retreating blade, and reasonable Mach number of the advancing blade tip. Fig. 1 showed the relationship of these variables, and consisted simply of Mach number indications superimposed on a plot of the equation:—

$$V_L = \tfrac{3}{4}V_T - 31.3\sqrt{\text{blade loading, ft/sec}} \quad \ldots\ldots\ldots (1)$$

The graph also showed a relation between blade loading and tip speed corresponding to optimum hovering conditions. This line, which was sometimes useful for estimating purposes, was derived from the equation:—

$$V_{T_{opt}} = 65.0\sqrt{\text{blade loading, ft/sec}} \quad \ldots\ldots\ldots\ldots (2)$$

For his example, Mr. Fitzwilliams stated that he had assumed a maximum forward speed of 120 m.p.h. at sea level I.C.A.N. conditions at normal load, and a rotor tip speed of 550ft/sec in all conditions of flight. From Fig. 1, the corresponding maximum blade loading was 57 lb/sq ft to ensure freedom from blade stalling, giving the low Mach number of 0.65 at the tip of the advancing blade. These conditions were identified by point A on the graph, and this location, related to the "optimum hovering" line, was an indication that the examples did not necessarily represent the best possible performance.

Having found the blade loading, it was convenient next to consider the blade aspect ratio. The lecturer said he had attempted only a crude estimation of the highest aspect ratio likely to give adequate strength and stiffness. For this purpose, Fig. 2 offered a rough guide, since it showed a family of blades of constant total area, but varying aspect ratio, each carrying a pair of jet engines of appropriate size, housed side by side in a common nacelle at the blade tip.

That even a rough estimate would probably not be very misleading was indicated by Fig. 2. The profile drag power was not affected by blade length in this case, since the blade area and tip speed were constant. The induced power varied inversely with blade length, but for high solidities this variation was not very sensitive to changes in aspect ratio. If a solidity was chosen from the right-hand side of Fig. 2, therefore, subsequent more pessimistic correction would be unlikely to affect the results to a serious extent. He had assumed a solidity of 0.114, and later checks indicated that this was about right from the structural viewpoint. Combined with the 57 lb/sq ft blade loading, it corresponded to a disc loading of 6½ lb/sq ft and, because the disc loading was con-

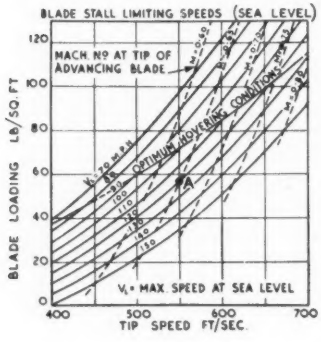


Fig. 1. Limiting curves for blade stalling and reasonable Mach number.

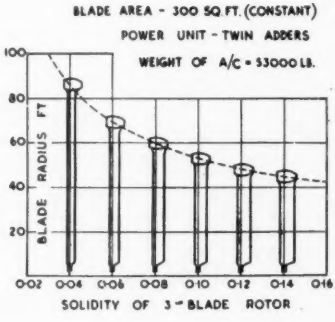
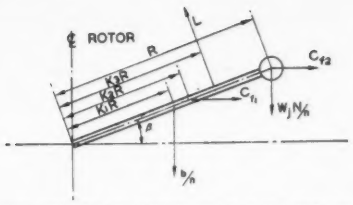


Fig. 2. Variation of aspect ratio for a family of blades of constant area.



FORCES AND MOMENTS ON HINGED ROTOR BLADE WITH TIP ENGINE

Lift on Blade	$L = \int_0^R l.dr.$	Centrifugal Force of Blade Weight	$Cf_1 = \frac{\omega^2}{g}\int_0^R w.r.dr.$
Lift Moment	$M_L = \int_0^R l.r.dr.$	Centrifugal Moment of Blade Weight	$Mcf_1 = \beta\frac{\omega^2}{g}\int_0^R wr^2dr.$
Blade Weight	$b/n = \int_0^R w.dr.$	Centrifugal Force of Engine Weight	$Cf_2 = \frac{\omega^2}{g} \times \frac{NW_jR}{n}$
Blade Weight Moment	$M_b = \int_0^R w.r.dr.$	Centrifugal Moment of Engine Weight	$Mcf_2 = \frac{\beta\omega^2}{g} \times \frac{NW_jR^2}{n}$
Engine Weight	N.W$_j$/n	Coning Angle (Considered small)	β Radians
Engine Weight Moment	N.W$_j$R/n	Angular Velocity	ω Radians/seconds

$$\frac{b}{W} = \frac{K_3 - \frac{N.W_j}{W}\left(1 + \frac{\beta V_T^2}{Rg}\right)}{K_1\left(1 + \frac{K_2\,\beta V_T^2}{Rg}\right)} \quad \text{Eqn. (4)}$$

Fig. 3. Blade coning equilibrium.

stant for the entire family, the variation of gross weight could conveniently be plotted for the family as a function of rotor radius.

It had been assumed that all helicopters of the family were fitted with jet engines having a sea level static thrust given by the equation:—

$$\text{Static Thrust} = \frac{1.625W}{550}\sqrt{\frac{\text{disc loading}}{2\rho_o}}, \text{ lb} \quad \ldots\ldots\ldots (3)$$

This variation of static thrust gave a reasonable level of performance, and was convenient in that it expressed power requirements in terms of gross weight and hence in terms of rotor radius.

In estimating the weight of the rotor blades, it had been assumed that they were freely hinged at the rotor centre line.

The forces and moments acting on such a blade were shown in Fig. 3, and using the notation of this figure, it could be shown that the ratio of blade weight to aircraft gross weight was:—

$$\frac{b}{W} = \frac{k_3 - \frac{NW_j}{W}\left(1 + \frac{\beta V_T^2}{Rg}\right)}{k_1\left(1 + \frac{k_2\beta V_T^2}{Rg}\right)} \quad \ldots\ldots\ldots\ldots\ldots (4)$$

where W_j was the weight of the jet engine attached to each blade tip.

Mr. Fitzwilliams had also assumed that the modifications needed to render a normal turbojet suitable for operation at the tip of a rotor blade would not add materially to the weight of the engine. In any case, quite large errors in this assumption would have little effect on the analysis. A plot of the relationship between static thrust and weight for various existing turbojets was given in Fig. 4, and indicated that a suitable assumption was represented by the equation:—

$$W_j = 250 + 0.3 \text{ (Static Thrust), lb} \quad \ldots\ldots\ldots\ldots\ldots (5)$$

Since the static engine thrust was taken to be a function of gross weight and, therefore, of rotor radius so, by means of equation (5) the engine weight could also be determined as a function of rotor radius. The engine weights could then be substituted in the blade weight equation (4) from which it was possible to plot the ratio of blade weight to gross weight as in Fig. 5A, B and C, these showing the variation of this ratio with rotor radius for constant coning angles of 4, 6 and 8 deg.

These figures showed the large reduction in total blade weight which could be achieved by the addition of tip jet engines as compared with blades of conventional weight distribution. They also indicated how the ratio of blade weight to gross weight might be controlled by small increases in coning angle with increasing size, so as to remain, even for very large helicopters, within the limits to which we were now accustomed on small helicopters. These graphs, moreover, related to a family of rotors of constant tip speed and disc loading, whereas in the larger sizes, the rotational speeds were so low, and the ground effect so powerful, that both tip speed and disc loading would probably be increased in the event, so providing additional means of blade weight control effective well beyond the range of foreseeable size requirements.

Whereas there appeared to be no significant upper limit to the size of this family of rotors, Fig. 5A, B and C suggested that there was a lower size limit below which this type of rotor ceased to be attractive. This was shown by the dotted and chain-dotted lines superimposed on the main curves. These lines gave a rough indication of the weight of blade material likely in any case to be necessary to provide sufficient strength and stiffness, but it was obvious from Fig. 5A (point B) that even gross errors in the estimates would hardly alter the indicated radius of about 50ft, below which the advantages of a tip-mounted turbojet installation began to be lost.

The lecturer stated that in his examples the blade weight was assumed to be 5 per cent of the gross weight for values of rotor radius from 50ft up to approximately 90ft, indicating a gradual increase in coning angle with size. Beyond 90ft

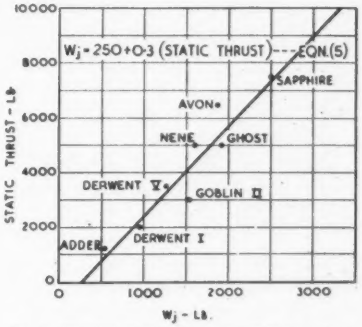


Fig. 4. Plot of static thrust against weight for various existing turbojets.

radius, he had assumed that the ratio of blade weight to gross weight increased as indicated by the lower line of Fig. 5C, since a coning angle of 8 deg corresponded roughly with the upper limit of present experience.

Having accounted for the weight of blades and engines, it was necessary to assume certain percentages of the gross weight as representing the fuselage structure, undercarriage, etc., and the percentages chosen corresponded to the average achieved in present conventional helicopters. On this basis, the fuselage of a jet-driven helicopter might reasonably be expected to be lighter than assumed here, since it would be proportionately much shorter and also free from the large tail rotor thrust moments of the conventional type. The percentages assumed were as shown in Table I.

TABLE I
Structure-weight Breakdown

	per cent
Rotor head	3.80
Tail rotors	0.40
Fuselage	13.00
Landing gear	4.00
Flight controls	1.50
Fuel system	2.00
Transmission (tail rotors)	0.20
Hydraulics	0.40
Electrics	1.20
Miscellaneous (radio, instruments, etc.)	1.50
Total structure (less blades and power units)	28.00

THE GIANT HELICOPTER . . .

Under the heading "The Family of Giants," Mr. Fitzwilliams then went on to say that, because the gross weight, blade weight and engine weight were known as functions of rotor radius, whilst the structure weight was a simple percentage of the gross weight a fairly comprehensive weight analysis for the entire family could therefore be plotted, as in Fig. 6, which was so arranged that the space below the lowest full curve represented the disposable load for each size of rotor. The magnitude of these loads might be appreciated by reference to the right-hand scale, graduated in tons. When it was realised that, in rough figures, ten troops with normal equipment were equivalent to one ton, the scale on which such helicopters could be used for the transport of troops and equipment would seem to introduce new possibilities in the concept of the air transportable army, and even in the task of evacuating civil populations in large-scale emergencies.

The disposable loads indicated in Fig. 6 referred to the normal operational weights, but the extremely powerful ground effect associated with the larger helicopters would permit large increases in the already impressive normal lifting capacities. Practical measurements with existing helicopters had shown that the beneficial effect of the ground cushion extended to a height considerably greater than one rotor diameter and, in fact, consistent indications had been given that the effect was still noticeable as high as two rotor diameters from the ground. Even accepting the usual single-rotor diameter standard, it would be realised that the ground effect assumed a new significance when it remained powerful at wheel clearances of over 100ft.

Relating the power requirements of this range of helicopters to the characteristics of existing turbojet units, the generalized size range of Fig. 6 could be reduced to the specific examples illustrated in the upper half of Fig. 7, although the advantages of this type of rotor drive might not be fully effective for the smallest example quoted, in which the rotor radius was considerably less than 50ft. It was even doubtful whether the smallest example properly came within the scope of the paper, although it might be well-suited to airline operation. Mr. Fitzwilliams remarked that it was,

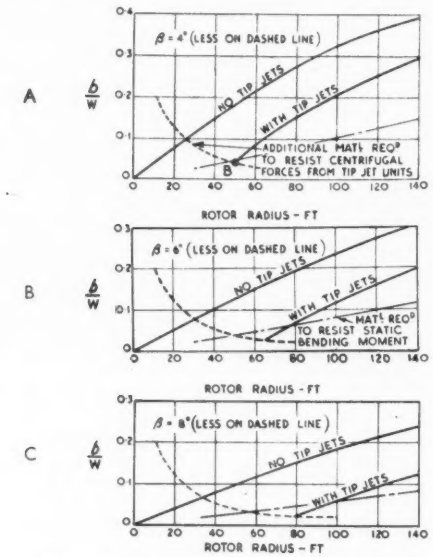

A
B
C
b/W
β = 4° (LESS ON DASHED LINE)
NO TIP JETS
WITH TIP JETS
ADDITIONAL MAT¹ REQ'D TO RESIST CENTRIFUGAL FORCES FROM TIP JET UNITS
B
β = 6° (LESS ON DASHED LINE)
MAT¹ REQ'D TO RESIST STATIC BENDING MOMENT
β = 8° (LESS ON DASHED LINE)
ROTOR RADIUS - FT

Fig. 5. Ratio of blade-weight to gross-weight variation with rotor radius for coning angles of four deg (A), six deg (B), and eight deg (C).

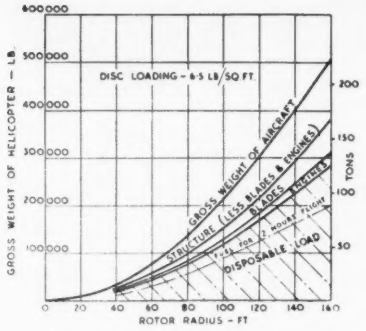


Fig. 6. Generalized size range/weight analysis.

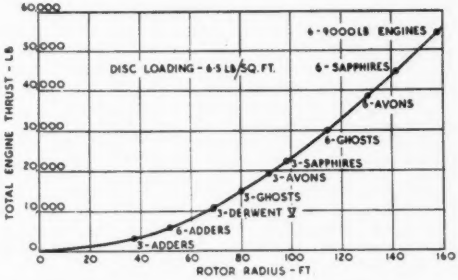
after all, only a very little giant. Its size was less than that of one rotor of the new Piasecki, and its lifting capacity hardly extended beyond 50 passengers!

From the table in the lower half of Fig. 7, it could be seen that the centrifugal acceleration and yawing velocity to which the largest engine would be subjected were (at 60 g and 3.5 rad/sec) of an order very different from the conditions which would have to be considered in the application of tip engines to a small rotor. These figures might be compared with the values of approximately six g and three rad/sec for which turbojet engines were normally designed.

Proceeding downwards in the scale of size, the rotor diameter was reduced from 316ft to 16oft before the severity of engine operating conditions was doubled as compared with the largest size. A factor of three on the least severe case would cover the range of true giants.

Mr. Fitzwilliams observed that the most optimistic presentation would not disguise the severity of the conditions indicated by this table, but the gloomy impressions to which it might give rise at first sight did not seem to be justified even in respect of ordinary turbojet engines, as he would hope to demonstrate in the concluding section of the lecture. (A digest of this will be published in the next issue of *Flight*.)

The proposals put forward by Mr. Fitzwilliams are certainly startling, but are not of so heterodox a nature as to be beyond the pale of possibility, for they are essentially concerned with mechanical design.

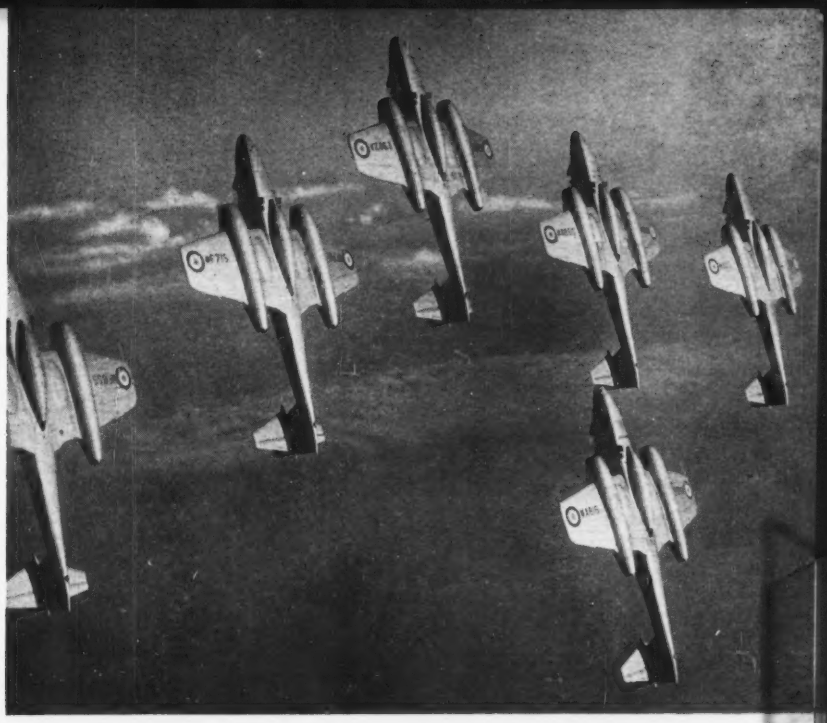


WEIGHT OF A/C	ROTOR DIA	ROTOR R.P.M.	ENGINE	ENGINE THRUST	No. USED	$\dot{\theta}$	$\ddot{\theta}$
504,000 LB	316FT	33	—	9,000 LB	SIX-PAIRED	3.5	60
410,000 LB	284FT	37	SAPPHIRE	7,500 LB	SIX-PAIRED	3.9	66
355,000 LB	262FT	40	AVON	6,500 LB	SIX-PAIRED	4.2	72
276,000 LB	228FT	46	GHOST	5,000 LB	SIX-PAIRED	4.8	82
206,000 LB	196FT	53.5	SAPPHIRE	7,500 LB	THREE	5.6	96
180,000 LB	182FT	58	AVON	6,500 LB	THREE	6.0	103
137,000 LB	160FT	65.5	GHOST	5,000 LB	THREE	6.9	118
100,000 LB	136FT	77	DERWENT V	3,500 LB	THREE	8.1	138
53,000 LB	104FT	101	ADDER	1,000 LB	SIX-PAIRED	10.6	181
29,000 LB	76FT	138	ADDER	1,000 LB	THREE	14.5	248

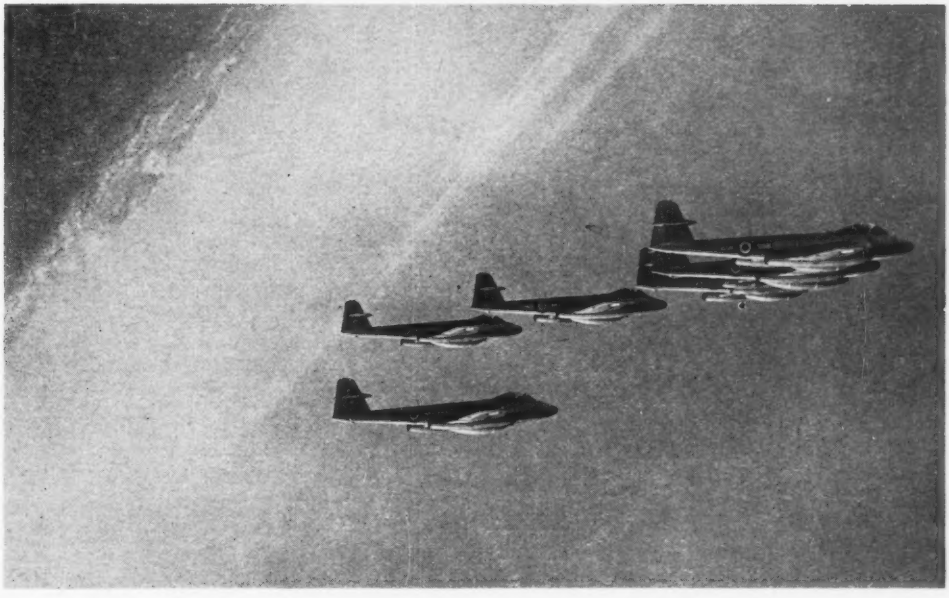
$\dot{\theta}$ RADIANS/SEC. ANGULAR VELOCITY IN YAW OF TIP JET ENGINES AT A CONSTANT SPEED OF 550 FT/SEC.
$\ddot{\theta}$ CENTRIFUGAL INERTIA ON TIP JET ENGINE.

Fig. 7. Helicopters with particular engines.

WHICH WAY UP?



"Flight" photographs.

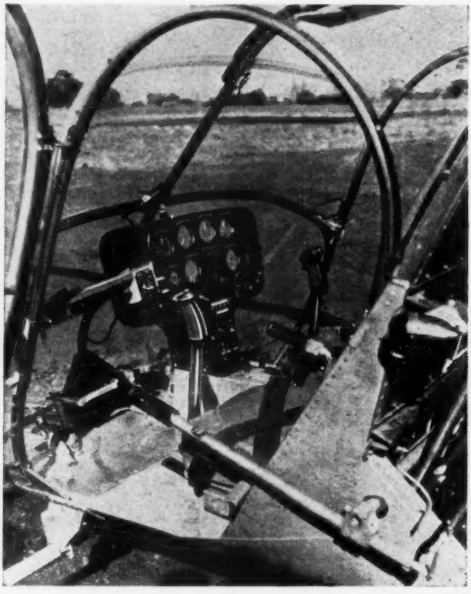


PUBLICATION a fortnight ago of the air-to-air photographs of No. 66 Squadron's aerobatic team has revived the old question of "which way up?" Readers have written in appreciation of the pictures—and to say that they think the horizon should be level; others demand that "as the photographer saw it" is the proper way up. To aid readers to make their own decisions in this matter, a further two photographs, obtained on the same flight, are published above. The upper of these follows the dictates of the "level horizon" school, while the lower picture is presented as seen from the Meteor 7. One of the difficulties in deciding the question lies in the fact that the reader looks straight forward and downward on the page, whereas the photographer may have been screwing his neck to the limit to get the aircraft in his sights. To look at the top photograph properly one should strap oneself by the shoulders to a chair, look hard over the left shoulder and, if possible, suspend the chair at right angles from the wall!

The most noticeable modification in the Hiller H-23B is the use of a skid undercarriage, with "turn-up" wheels. In the cockpit view, below, it will be seen that the control-column mounting is now conventional.

HELICOPTERS IN UNIFORM

The H-23B Development of the Hiller 360, for Service in Korea: More Power



WERE any proof still needed of the value of the helicopter as a military vehicle, particularly in the field of rescue and communications work, the Korean War has supplied it in plenty.

More and more aircraft of this type are being ordered, and American manufacturers, in particular, are now hard-pressed to fulfil demands. Last autumn, Hiller Helicopters, Inc., of Palo Alto, California, who for three years had been producing the 178-h.p. Hiller 360 series of civil helicopters, had to switch their production capacity to Government requirements. The 360 basic design was modified to meet military specifications and, within ten days of the switch-over, the new H-23s were coming off the production line. Immediate modifications had included a change-over from overhead cyclic-control column to the more usual floor-mounted stick-column, and the incorporation of much military radio and electronic equipment, details of which are not disclosed.

Subsequent operation of H-23s in Korea showed that the 178-h.p. Franklin engine was not powerful enough to give good performance with the 400 lb of extra weight added by the modifications. Early this year, therefore, the firm started to redesign the machine; a 200-h.p. Franklin, a more robust structure and transmission, and some 50 other major modifications were incorporated. Much of the work was on the direct suggestion of helicopter pilots who had returned from the war zone. The resultant H-23Bs are already on their way to Korea in large numbers, only nine months after the redesign was started.

Leading data on the H-23B are: Empty weight (including military equipment), 1,756 lb; useful load, 744 lb; gross weight, 2,500 lb. The power unit is the Franklin 6V4-200-C33.

FUTURE OF GAS-TURBINE FUELS

THE increasing development of gas-turbine aircraft has drawn attention to the need of adequate supplies of suitable fuel, particularly as the present-day jet-propelled aircraft normally uses kerosine, the yield of which represents only some 6 per cent. of all derivatives obtainable from crude oil. But (says the Petroleum Information Bureau, in its latest memorandum, *Jet Aircraft Fuel*) a much wider range of turbine fuels could be produced in case of need, representing, if necessary, up to 50 per cent of all crude-oil supplies, although this would only be possible at the expense of other users of petroleum products.

The memorandum reiterates the now well-known fact that, for short stages (i.e. about 200 miles) the piston engine is still the cheaper to operate. Its cost per aircraft-mile works out at 14s 9d against 14s 11d for a turboprop and 16s 11d for a turbojet. For stages of 500-1,000 miles, the turboprop aircraft comes into its own, for while operating costs are comparable with those of piston-engine types, the turboprop offers its great advantage of freedom from vibration and noise. On longer stages the pure jet becomes increasingly attractive: over a distance of 1,500 miles, for instance, its greater speed can mean a saving of perhaps 2½ hours on piston-aircraft time and 1½ hours over turboprop time.

The general conclusion of the memorandum is that with the growing development of jet propulsion, the kerosine fuel now in general use will, when demand makes it necessary, be replaced by a broader-based petroleum fuel.

AN END TO PLUG-FOULING?

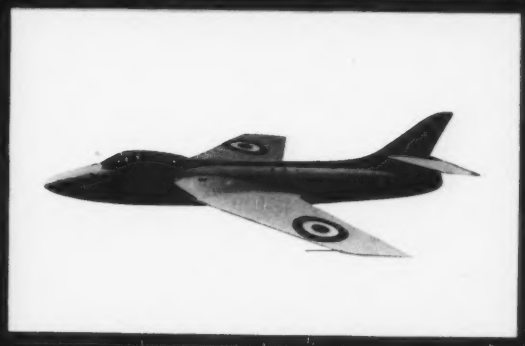
IF recent reports are reliable—and there is no reason to think them otherwise—the problem of sparking-plug fouling by leaded fuels is in a fair way to being solved at last. When it is remembered that the largest piston engines have 28 cylinders with two plugs per cylinder, so that there are no fewer than 224 plugs in a four-engined aircraft, the magnitude of the maintenance problem involved, from the operator's point of view, can be appreciated.

Shell research engineers on both sides of the Atlantic have recently advanced to the flight-test stage the addition to aviation gasoline (in minute quantity) of a well-known chemical, tricresyl phosphate. In the U.S.A. successful tests have already been carried out under Air Force auspices; and in the United Kingdom B.O.A.C. will soon be embarking on trials under normal commercial operating conditions. The development is covered by pending patent applications.

The flight-test programme has been preceded by a period of exhaustive testing by engine manufacturers, during which, it is claimed, this chemical additive has been shown not only to reduce sparking plug trouble, but also to minimize the risk of exhaust-valve failure.

The benefits of adding tricresyl phosphate derive from its property of modifying the deposits inevitably formed in the cylinders, rendering them neither electrically conductive nor corrosive to valve material, even at high operating temperatures.

You
can always
tell a
thoroughbred



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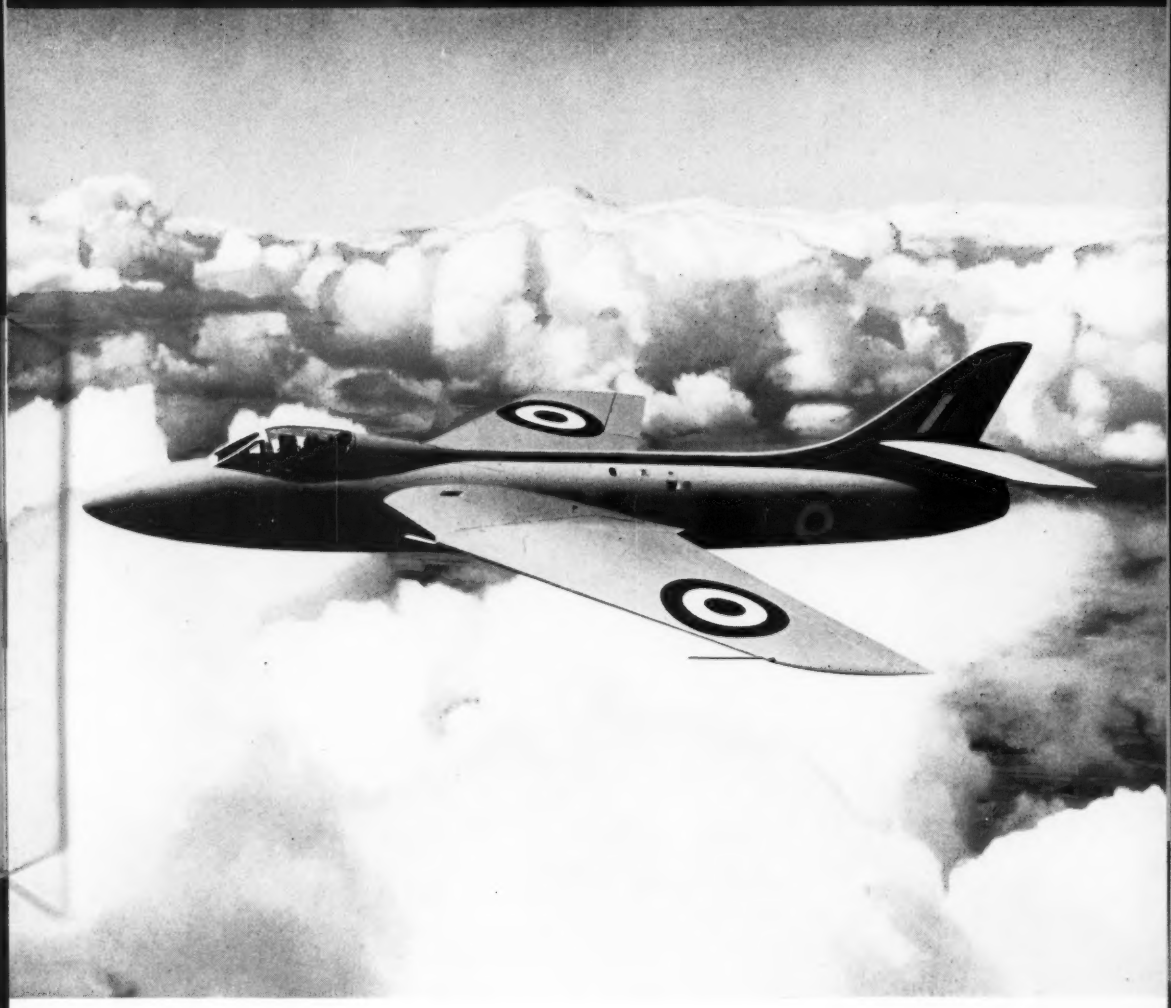


The blue-ribbon Hawker P.1067

'THE WORLD'S FINEST FIGHTER'

The traditionally clean line, which aviation has come to expect in every thoroughbred from the Hawker stable, clearly proclaims the ancestry of Sidney Camm's sensational P.1067 — fastest fighter in the world. With great manœuvrability and dazzling rate of climb, the P.1067 packs a punch unparalleled in fighters. Ordered by the R.A.F. from the drawing board, the P.1067 is a true inheritor of Hawker's traditional supremacy in single seater fighters . . . an outstanding achievement in the company's 38 year history of aviation leadership.

HAWKER AIRCRAFT LTD., KINGSTON-ON-THAMES · SURREY

MEMBER OF THE HAWKER SIDDELEY GROUP / PIONEER . . . AND WORLD LEADER IN AVIATION

The Tabloid makes its bow at Hendon (November 29th, 1913).

Forty Years of Sopwith and Hawker Aircraft

By - - - - - H. F. KING, M.B.E.

FIGHTING BREED

IT is the chilly afternoon of Saturday, November 29th, 1913. Fifty thousand people have passed through the turnstiles at the London Aerodrome, Hendon, and shortly after 2 o'clock the flying begins. There is a fine selection of types to watch—a Farman, a Morane, a pair of Grahame-Whites, a Caudron and a Breguet—and all the pilots are on their mettle.

A Grahame-White has just landed from an exhibition flight with a passenger when suddenly a strange biplane is seen approaching over West Hendon at a phenomenal rate. Buzzing across the boundary, the tiny machine makes two circuits of the aerodrome at a speed estimated by timekeeper George Reynolds to be well-nigh 90 m.p.h.

The *cognoscenti* correctly identify it as the new 80 h.p. Gnome-Sopwith, piloted by the young Australian Harry Hawker, but few are aware that, on this very morning, it has been timed over the measured mile at Farnborough at the record speed of 92 m.p.h. The minimum speed has been established as 36.9 m.p.h. and in one minute a height of 1,200ft has been achieved—all this while carrying a passenger and fuel for 2½ hours!

The crowds are quick to sense the drama of the occasion. Britain is setting the pace . . .

Thirty-eight years, blighted by two great wars, pass by. It is the 1951 Display and Exhibition of the Society of British Aircraft Constructors at Farnborough—the same old Farnborough where, on that winter's day in 1913, the Sopwith Tabloid (as the tiny biplane was to become known) left a trail of shattered air records behind it. The flying programme is well advanced and it is now the turn of the fighters to show their paces before the world's technicians. There is a brief pause in the proceedings; then, swift as lightning, something blue-green—it is almost impossible to identify it—flashes along the enclosures at perhaps 500ft, leaving behind it a stunning blast of shock and sound. The crowd is stupefied, and, as heads turn for a glimpse of the projectile, it is seen far distant, rocketing skywards, rolling, rolling, and again rolling, until lost from sight.

The commentator (who has "muffed" the microphone in his confusion and uttered some mild profanity) relieves the tension. "You have just seen," he announces, "the Hawker P.1067, flying at a speed probably in excess of the world's record—a speed approaching 700 miles an hour."

Once again, it seems, Britain is setting the pace . . .

T. O. M. Sopwith in the Howard Wright biplane which, by Royal command, he landed on the East Terrace of Windsor Castle on Feb. 1st, 1911.

Between these two incidents, in time so far removed, yet in circumstance and significance so strikingly similar, is a relationshid of the most real and intimate kind—the kinship of a great line of fighting aircraft which, for inbred excellence and continuity of achievement, admits no peer; aircraft like the Pup, 1½-Strutter, Camel, Fury, Hart, Hurricane, Typhoon, Tempest and P.1067, backed by men like T. O. M. Sopwith, Harry Hawker, Fred Sigrist, Sydney Camm, "George" Bulman and the brothers Spriggs. And of these names we are first concerned with that of Thomas Octave Murdoch Sopwith.

It was October 22nd, 1910, when 22-year-old Tom Sopwith put in his first appearance at Brooklands in proud possession of a Howard Wright Avis monoplane with 40 h.p. E.N.V. engine. That he had never flown a heavier-than-air machine seemed to him the best possible reason for mounting to the cockpit and opening the throttle. The four-abreast wheels rose from the grass and all went well for, perhaps, 300 yards, when, in his exuberance, the daring young man pulled abruptly on the control column. The gawky monoplane reared up, stalled, and flopped back to earth with a resentful rending and snapping. Sopwith walked off to seek instruction.

He was a diligent pupil and on November 22nd, 1910, Royal Aero Club Aviator's Certificate No. 31 was issued to him. Four days later, in a newly acquired Howard Wright biplane (60 h.p. E.N.V.), he established a British duration record by remaining airborne for 3 hr 12 min.

The last weeks of 1910 saw him engaged in a ding-dong battle with the veteran Cody and the resolute Alec Ogilvie for the Michelin Cup (which Cody finally wrested from him by a 35-mile margin), and from this narrow defeat he went on to vie with other seasoned pilots—Grahame-White and Frank McClean among them—for the £4,000 Baron de Forest prize, offered for the longest flight from England to the Continent. Setting out from Eastchurch on Sunday morning, December 18th, 1910, he headed the Howard Wright for Dover, and 22 minutes later crossed the French coast near Cap Gris Nez on course for Chalons. Over France an erratic compass obliged him to navigate by the sun, but even this elementary "navaid" was soon denied him by an interposed cloud. Unknown to him, his machine began to veer to the left, over the Belgian border and across hilly country, where the air was so turbulent that he was once unseated and deposited on the wing. Seeing no way through the hills, he alighted at Beaumont after being 3½ hr in the air; he was 169 miles from Eastchurch. Disgust that half his fuel remained changed to elation when he realized that continuance on his course would have actually decreased the distance from his point of start; as it was the £4,000 was his.

Never was he to experience a prouder moment, however, than on February 1st, 1911, when, by Royal Command, he set the Howard Wright down on the East Terrace of Windsor Castle. Though he had been delayed by a forced-landing at Datchet, His Majesty King George V was waiting to receive him and question him about his machine.

Fame was already achieved and fortune smiled.

Having found a new joy in the beautifully constructed Martin and Handasyde monoplane, young Sopwith went over to Paris with Gustav Hamel to try out one of the new 70 h.p. Gnome-Bleriots. This he felt he had to own, and soon he was crating it up, together with his faithful Howard Wright, and setting out to "show America." His sister May went along as business manager and the redoubtable Fred Sigrist (formerly responsible for keeping Mr. Sopwith's cars and motor boats in trim) was appointed chief engineer. Thus equipped and supported he could hardly fail.

FIGHTING BREED . . .

He quickly became the first man to fly over Philadelphia and the first in America to fly for more than an hour with two passengers. At the Chicago meeting alone he netted 15,000 dollars prize money and at Boston a further 6,000, on the strength of which successes he ordered a Burgess-Wright biplane and shipped it home with him in October.

In 1912, with that prescience which has richly rewarded him—and this nation—over so many years, he founded the Sopwith Flying School, at Brooklands, and the Sopwith Aviation Company, acquiring as premises for the latter enterprise a roller-skating rink near Kingston-on-Thames station and installing Fred Sigrist as manager. The venerable rink, having twice changed hands, remains to this day as the tool room of Hawker Aircraft, Ltd.

The year 1912 was not one solely of new business departures but of good sport as well, for June was the month of the first Aerial Derby, flown over an 81-mile course round London, starting and finishing at Hendon. Not unexpectedly, Sopwith was first over the line in his two-seater Bleriot, his victory, incidentally, being due in some measure to one of the earliest instances of "cleaning-up" for racing in that he had covered-in the openwork fuselage of his machine with fabric, thus gaining a few miles an hour over Hamel, who was similarly mounted.

There now arrived on the scene the slender figure of young Harry Hawker, whose achievements will have a prominent place in our story. Hawker had come over from Australia with his friends Busteed, Harrison and Kauper, and after working at Kingston as a mechanic (fifteen hours a day, seven days a week, with £2 at the end of it) was enabled to take his certificate on September 17th, 1912, at the Sopwith School.

Inexperience notwithstanding, Hawker displayed such qualities of airmanship that within a few weeks he had been appointed test pilot to the Sopwith Aviation Company. Such was his calibre, indeed, that on October 24th, 1912, he broke the British duration record by remaining airborne for 8 hr 23 min, thus simultaneously securing the Michelin Trophy for that year and a cash award of £500. His machine was a rebuilt version of Mr. Sopwith's Burgess-Wright, powered with an A.B.C. engine in place of the original Gnome. It had twin, chain-driven, pusher propellers and was known as the Sopwith-Wright or Sopwith-Farman, for it embodied Farman-type controls.

Notwithstanding Mr. Sopwith's past successes with monoplanes, the energies of the new design-and-construction team (for truly a team it was, like its Hawker counterpart of today) were now firmly committed to the development of biplanes, and the first of these was a tractor machine having a 70 h.p. Gnome engine and embodying Wright wings and a Farman undercarriage. Though itself of Franco-American parentage, it was, nevertheless, the true sire of the pure-blooded Sopwith strain.

At the Olympia Aero Show in February, 1913, two very advanced Kingston-built biplanes were exhibited and both were bought by the Admiralty. On these *Flight* pronounced: "They are no freak machines, these two biplanes of Sopwith's: a rough glance over them will soon convey to the observer that they are designed by practical men. Of the two, the hydro is the more interesting since it is the more original."

The Bat Boat (as the "hydro" was to become known) reflected Mr. Sopwith's interest in high-speed marine craft and, in all justness, the influence of the American Glenn Curtiss. The cedar-wood hull was constructed by that artist in wood Sam Saunders, of Cowes, and the tail was carried on outriggers; the engine was a 90 h.p. Austro-Daimler. The second type, commonly known as the Three-seater Tractor, was a landplane of notably clean design and carried a useful load of 450 lb at 70 m.p.h. on 80 h.p. The pilot sat in the rear cockpit, with the two passengers side by side ahead of him. Flown by Hawker, this excellent machine proceeded to clean up a number of prizes and records. First it won the Whit Monday cross-country race from Brooklands; then, at Hendon, the altitude prize, and next—flown solo—it established a new height record (formerly held by Mr. Geoffrey de Havilland, in a B.E.) by attaining 11,450ft, at which level the carburettor froze. Later, with one passenger, Hawker took it up to 12,900ft (thus beating his own solo record) and, soon afterwards, with two passengers, to 10,600ft. Characteristically, the young Australian and his chief were even now unsatisfied, and on July 27th, 1913, the Three-seater ascended to 8,400ft while carrying Hawker and *three* passengers.

The improved Bat Boat of 1914, with 200 h.p. Canton-Unné engine.

Below: 1½-Strutter two-seater fighter, with 110 h.p. Clerget engine.

The Bat Boat was likewise to distinguish itself in competition flying. On July 8th, 1913, in an amphibian version, powered with a Green engine, Hawker carried off the £500 Mortimer Singer Prize for the first all-British aircraft to make six consecutive flights between two points five miles apart, one of which (marked by a buoy in the Solent) was on water and one (at Cowes) on land. A developed version of the Bat Boat, built entirely at Kingston and powered with a 200 h.p. Canton-Unné 14-cylinder water-cooled engine, was acquired by the German Government, and a third variant, with a 200 h.p. Sunbeam, was developed for the 1914 *Daily Mail* Round-Britain Contest, though this race never took place due to the outbreak of war.

During the previous year (1913) a Sopwith three-seater, twin-float seaplane, with 100 h.p. Green engine, had put up an epic performance in a similar contest. On this occasion, with a £5,000 prize in prospect, Hawker and his friend Kauper were left alone in the field, mishap or disaster having overtaken their rivals. After a chapter of accidents and adversities the Sopwith itself came to grief when Hawker's foot slipped from the greasy rudder bar, dipping a wing-tip into the sea. But the young Australian had put up such a plucky show, and the Sopwith had demonstrated such an excellent flying performance (having covered over a thousand miles in about twenty hours) that the *Daily Mail* sportingly awarded Hawker a special prize of £1,000.

The Tabloid

The year 1913 was, indeed, one of transcendent Sopwith achievement, reaching its zenith in November with the introduction of the sensational little Tabloid, to which the reader was introduced at the outset of our story.

Designed, in considerable secrecy, for demonstration flying, the Tabloid was truly of revolutionary design in having single-bay wings (of only 25½ft span) and in displaying an exceptional degree of aerodynamic cleanness. Lateral control was achieved by wing-warping, though in subsequent single-seater military models, this system gave way to ailerons.

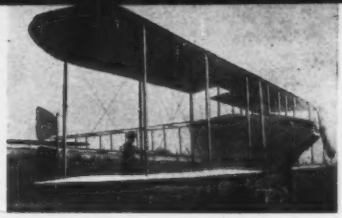
With a Tabloid among his luggage, Hawker sailed for Australia early in 1914 for a propaganda and demonstration tour on which he improved the shining hour by giving joy-rides at £20 a time. During his absence many of his duties were taken over by Howard Pixton, a fine pilot who was to bring new honours to Britain and to the name of Sopwith. But that the company's name was already one to reckon with is shown by the following effusion by "Will o' the Wisp" in *Flight* of January 10th, 1914: "'Sopwith Aviation Company, Ltd. December 15th, 1913. £26,000 (£1) (6,000 six per cent cum. pref. and 20,000 ord.); To take over,' etc. Um—sounds all right. Fast little beggar that new Baby-plane. Good Hydro, too, that one that nearly got round the circuit. Clever chap T.O.M., clever men with him, too: what are we going to see in 1914?"

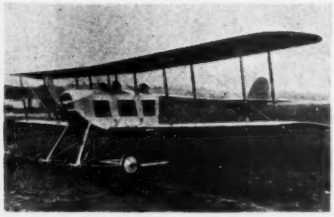
This puckish inquirer had not long to wait for an answer, for during April, in face of formidable French opposition, Pixton secured the Schneider Trophy for Britain by averaging 86.8 m.p.h. over the Monaco course. His machine was sometimes known as the Schneider, but was merely a floatplane development of the Tabloid fitted with a 100 h.p. Mono-Gnome.

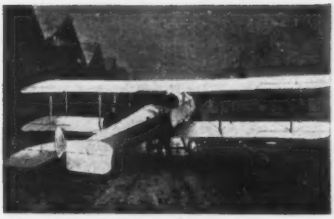
Pixton's victory sent our national prestige soaring to new heights: after his flight at Monaco, there had still been time for his rivals to improve on his performance, but they had not ventured off the water, in the realization that the little Sopwith was unbeatable.

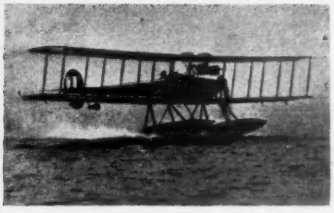
Harry Hawker came home on June 6th, 1914, and was at work next day, with Pixton and Victor Mahl to assist him. It will be gathered that even at this early date the company was aware that test pilots could make a major contribution to technical development, and it is no mere coincidence that Bulman, Lucas, Humble, Wade, Duke and the rest should have been men of exceptional qualities. Though far removed from the stunt-merchants, each has made some individual contribution to the twin arts of exhibition and demonstration flying, and Hawker himself was certainly no exception. It is told, incidentally, how, in Pixton's Schneider machine (by this time converted to a landplane), he essayed a loop without power. Failing to pull it tight enough, he stalled on top

A Sopwith Assortment . . .





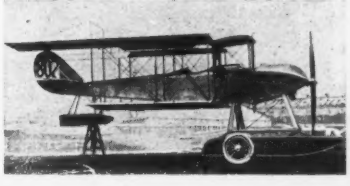


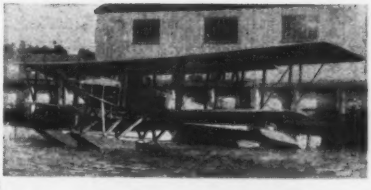


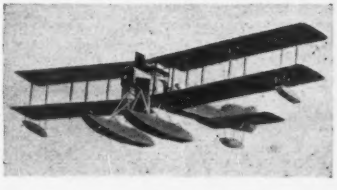
This column, reading down : Sopwith-Wright biplane of 1912 (40 h.p. A.B.C.) which, flown by Harry Hawker on October 24th, 1912, remained airborne for 8 hr 23 min, and secured the Michelin Trophy; Bat Boat amphibian of 1913 (100 h.p. Green), winner of Mortimer Singer Prize; Gordon Bennett Racer of 1914 (a high-speed development of the Tabloid); "Folder" seaplane of 1914 (100 h.p. Gnome); seaplane of 1914 (225 h.p. Sunbeam).

Right-hand column, reading down : Sopwith-Wright biplane of 1912 (70 h.p. Gnome), of Sopwith design, but incorporating Wright wings; side-by-side dual-control biplane built for Mr. Churchill; the original Tabloid, with undercarriage skids; "Daily Mail" biplane (80 h.p. Gnome) of 1913 (landplane shown); Gun Bus landplane; torpedo seaplane (200 h.p. Canton-Unné) of 1914; Baby seaplane.

This column, reading down : Three-seater Tractor of 1913 (80 h.p. Gnome); "Round Britain" seaplane for "Daily Mail" Prize (100 h.p. Green); 1913 Schneider seaplane (100 h.p. Gnome); Gun Bus seaplane (100 h.p. Anzani); Tractor seaplane of 1914 (100 h.p. Anzani).







FIGHTING BREED . . .

and went into an inverted spin—probably the first on record. The Schneider fell in a tree-top, slid to the ground, and, unharmed, the indefatigable Hawker wriggled clear. He was flying next day.

For the 1914 Gordon Bennett race a very clean-looking single-seater was developed, differing from the standard Tabloid in having a circular-section fuselage, with cockpit further aft, a redesigned tail and a remarkably modern-looking long-chord engine cowling. Had the war not intervened some spectacular level-speed performances would have been recorded to the credit of this little racer. But if the descendants of the Tabloid have been famed for one quality above all others, it has been for their extreme manoeuvrability; so in developing powerful, sensitive controls for demonstration flying Mr. Sopwith was at the same time perfecting a war-winning weapon.

The coming of war found the Sopwith Aviation Co. well established and with no fewer than eight types of aircraft already serving with the R.F.C. and R.N.A.S. There was the single-seater Tabloid with 80 h.p. or 100 h.p. Gnome; the two-seater Tabloid; the 80 h.p. instructional machine; Gun Bus; Bat Boat (200 h.p. Sunbeam); Schneider seaplane (Gnome); and two other types of two-seater seaplane, one with 100 h.p. Anzani, the second with 225 h.p. Sunbeam. Of these the Gun Bus was a pusher seaplane developed from a pre-war trainer well known at Hendon. A float-plane development—one of the first machines to carry a swivel-mounted gun in the nose of the nacelle—was ordered by the Greek Government, but on the outbreak of war the Gun Buses were commandeered, converted to landplanes and taken into service by the R.N.A.S. The Baby seaplane, directly descended from the Schneider victor, remained in service from 1915 until the war's end.

At the Front the Tabloid landplane served for scouting flights, for fighting (having a machine gun obliquely mounted on the fuselage side, or, in conjunction with deflector plates, firing ahead), and for bombing.

Of Tabloid bombers one of the war's undying stories is told—of how, on October 8th, 1914, with the city and airfield of Antwerp under fierce bombardment from the Germans and with the populace already fleeing, F/L. Marix and Sqn.Cdr. Spenser Grey set out to attack the airship hangars at Dusseldorf and Cologne. Spenser Grey was denied his primary target by a thick mist and dropped his bombs on Cologne's main railway station; but Marix fared better. In clear weather he saw the vast Dusseldorf shed ahead. Dipping the Tabloid's nose towards it he released at 600ft, and saw his two tiny bombs strike home, collapsing the roof and venting a great sheet of flame from the newly-finished Zeppelin Z.IX lying beneath. And so the David from Kingston dealt with a German Goliath.

During the first few months of the war Sopwith's Kingston production was concentrated on the established types already named, but on February 15th a new design materialized. This was an experimental torpedo-carrying seaplane with 200 h.p. Canton-Unné engine, and the forerunner of the Cuckoo. It was never built in quantity, but to an Admiralty order several 100 h.p. Mono-Gnome floatplanes, having folding wings for ship-board stowage, were turned out, and three of these operated against the cruiser *Königsberg* when that commerce raider was driven to seek shelter in an East African river during 1915.

The first war-time Sopwith to blazon its name over the Western Front (and surely it was the strangest name ever borne by a fighting machine) was the 1½-Strutter, which set an entirely new standard for two-seater fighters. On the 'Strutter appeared the first British synchronized-gun installation (Vickers, with Sopwith-Kauper gear) and the first application of the Scarff gun ring, mounting a Lewis gun. Tailplane incidence was adjustable,

Pup: Engine, 80 h.p. Le Rhone; armament, one Vickers gun.

Triplane: Engine, 130 h.p. Clerget; armament, one Vickers gun.

to allow for gunners of different weights and for general trimming purposes, and, close to the fuselage on the lower wing, were trailing-edge flaps—this, be it marked, in 1915/16.

In the early months of the war Sopwiths were solely Naval contractors and the first 'Strutter order, for 150 machines, was placed by the R.N.A.S. Most of these, however, were handed over to the R.F.C. to help in combating the Fokker scourge. Six hundred-odd were later built to the order of the R.F.C., and hundreds more were turned out, by the parent company or foreign licencees, for France, Russia, Belgium, Rumania, Italy and America. With this same type a world's height record of 23,980ft was established. A single-seater bomber version, having a 130 h.p. Clerget in place of the more usual 110 h.p. unit, saw service in limited numbers.

On February 9th, 1916, the Sopwith experimental department cleared a machine which, for behaviour and looks—indeed for its very name—was to become a universal pet; a machine which today makes strong air marshals go dewy-eyed in recalling it. This was the Pup, which had something of the Tabloid and 1½-Strutter in its make-up and which, with its 80 h.p. Le Rhone, or 110 h.p. Mono-Gnome, outperformed many fighters of greater power, especially at height. By early 1917 indeed, on the admission of Richthofen himself, the Pup had established its superiority over all its German opponents. Over a thousand were built for the R.F.C. and R.N.A.S.

Deck Flying

Tractability and low landing speed rendered the type admirably suited to ship-borne operation and, in company with 1½-Strutters, Pups did pioneer work in developing the technique of deck landing. It was a Pup, flown by Sqn.Cdr. Dunning, which, on August 2nd, 1917, made the first successful alighting on the deck of a ship at sea. The vessel concerned was the converted heavy cruiser H.M.S. *Furious*, fitted with a 228ft deck forward, and it was necessary for Dunning to "crab" the Pup over the deck, when it was hauled out of the air by main force. This gallant officer was killed on a further attempt, but later experiments led to success.

Pups and 1½-Strutters were often flown off platforms built over the gun turrets of cruisers and battleships, and on August 21st, 1917, Flt.Sub.Lt. Smart, operating from the cruiser *Yarmouth* in a Pup, shot down Zeppelin L.23 in flames.

Considered solely as a fighting machine, one of the Pup's few disadvantages was its light armament of a single synchronized Vickers gun, and this deficiency was to persist in the succeeding type, the almost equally famous Triplane—or, in the idiom of the year 1916, Tripehound.

Concerning the Triplane there are a number of points to bear in mind, the first of these being that it was not inspired by its Fokker counterpart; on the contrary, it is by no means certain that the Fokker triplane would have ever existed had not two of the first Sopwiths been delivered in error to the Germans instead of to the R.F.C.

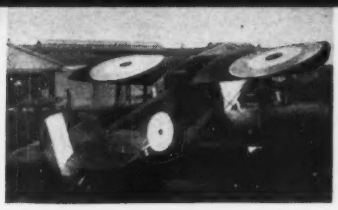
It is also well to appreciate the reasoning behind the Triplane formula. Somewhat surprisingly, perhaps, the pilot's field of view was exceptionally wide, for the wing chord was only 3ft 3in and sections were cut out of the centreplanes to afford downward vision. Furthermore, with the narrow chord, the centre of pressure movement with changes in incidence was small, allowing a very short fuselage and benefiting manoeuvrability. By reducing moments of inertia in a horizontal plane, the narrow span further enhanced manoeuvring power.

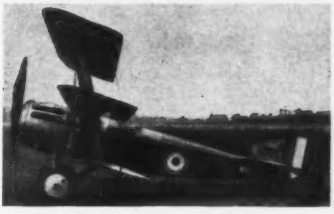
Another result of the small c.p. movement was to allow the use of single I-struts which, in conjunction with the sharp stagger, minimized certain of the "three decker's" inherent aerodynamic disadvantages. Though the wing loading was higher than the Pup's, the power loading was less, and all-round performance was superior.

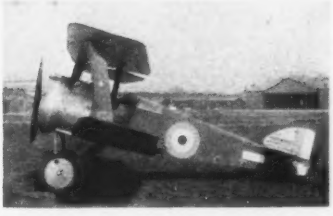
With the 130 h.p. Clerget engine the rate of climb was exceptionally good (10½ min to 10,000ft); in fact, nothing in the air—certainly not on the enemy's side—could surpass the Tripehound's ability to get upstairs. Though hardly as quick on the controls as the Pup, it handled sweetly, and it was a machine to which a pilot soon became attached.

Our story now brings us to late 1916 and into the company of

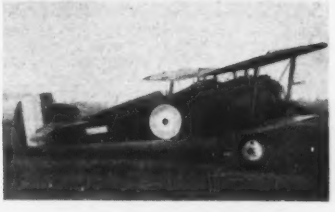
A Sopwith Assortment . . .



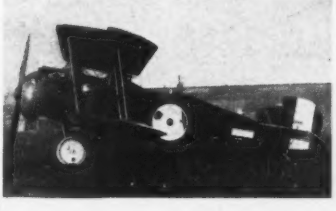




This column, reading down: Bee (a "sawn-off" Pup); experimental Triplane, with Hispano Suiza engine; prototype Dolphin, with frontal radiator; B.1 single-seater bomber; two-bay Bulldog.



This column, reading down: 1½-Strutter single seater bomber version; dual-control Camel conversion; experimental single-bay Snipe; Salamander (trench fighter version of Snipe); Hippo experimental reconnaissance aircraft, with 230 h.p. Clerget engine.



Right-hand column, reading down: Experimental three-seater triplane; R.N.A.S. Camel; taper-wing Camel; Cuckoo torpedo-dropper; Bulldog (single-bay); Rhino; Sparrow.

FIGHTING BREED...

a type which has often—and certainly not without justification—been described as the greatest fighter of the First World War. The prototype was passed out by the Sopwith experimental department on December 22nd and, due to the humped cowling over the breeches of its twin synchronized Vickers guns (but not, as some people believe, to the apparent anhedral of the upper wings, accentuated by the sharp dihedral of the lower wings) it was dubbed Camel.

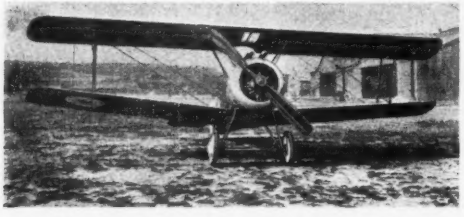
There was never a more aggressive looking single-seater—snub-nosed, compact in the extreme, and with the pilot seated far forward, with his guns and Aldis sight immediately to hand and eye. And not only in appearance was the Camel possessed of character. This was no easy-going Pup to suffer even fools gladly; but with the right hands on the stick it was the deadliest fighting machine in existence. Even its tricks and vices could be transformed into virtues. Its elevator was hypersensitive and the torque of the Le Rhone, Clerget or Bentley rotary caused it to turn with greater alacrity to the right than to the left. But the proof of this fierce little pudding of a fighter was in the destruction of more enemy aircraft than by any other machine of the Kaiser's war. At least three Camel-pilots claimed six e/a. in a single day.

The standard land-based Camel was the model F.1. For ship-board service a special version (2F.1) was developed, with a rack-mounted Lewis gun (for underneath attacks on Zeppelins) in place of one of the Vickers, and, in late series, a Bentley engine and detachable rear fuselage were embodied. It was a naval-type Camel, flown by Lt. S. D. Culley and launched from a 30ft platform built on to a destroyer-towed lighter, which shot down Zeppelin L.53 over the Heligoland Bight in August, 1918.

Camel power plants included the 110 h.p. Le Rhone, 130 h.p. Clerget (this was normal) and 150 h.p. Bentley A.R.1. Little-known variants of the machine were the tandem-seat trainer, used at Cranwell; a tapered-wing development with single interplane struts *à la* Triplane; and an armoured "trench fighter" (or ground-attack aircraft, as it would be known today) with special protective plating and downward-firing guns. The Camel was also adapted for air launching; it was, in fact, the second aircraft to be released from a dirigible, the first being a B.E.2c.

Though, as we shall see, the Camel was by no means the last of the handy fighting biplanes, there was never to be another type to rival its powers of lightning manoeuvre—at once the pride of its pilots and the bane of the Fokkers and Albatrosses. Fighters were thereafter to become larger, stronger, heavier and more elaborately equipped, and in the Camel's successor, the Snipe (7F.1) of 1917, we see an increase in span from 28ft to 31ft, and in weight from 1,450 lb to about 2,000 lb. The wing structure of the Snipe (except in an experimental single-bay model) was of two-bay type, of very great rigidity, and the fuselage, behind the large-diameter rotary engine, was of circular section.

In the opinion of the Sopwith company the air-cooled rotary had now reached, if not exceeded, its optimum size, and they were somewhat disappointed by the Snipe's performance.



A Clerget-powered Camel, showing the twin Vickers gun to advantage.

Below: A production-type Dolphin, with 200 h.p. Hispano-Suiza.

Nevertheless, there was general agreement that the Snipe was the finest all-round fighter in service at the war's end, though fewer than a hundred reached the Front. It was in one of these, on October 27th, 1918, that Major W. G. Barker, having shot down a two-seater from 21,000ft, was set upon by a Fokker and wounded in the thigh. The Snipe went spinning down out of control, but Barker recovered—only to find himself beset by fifteen Fokkers. Of these he damaged two and, from a range of 10 yards, sent a third down in flames. He was now hit for a second time and again spun down—this time unconscious. He came to, to find himself hemmed in by a dozen of the enemy and promptly—from less than 5 yards—shot the tail off one. As he did so a bullet shattered his left elbow. For a second time he fainted and with returning consciousness saw that he was still surrounded. The Snipe was by this time smoking heavily and, thinking it to be on fire, Barker resolved to bring a Fokker to earth with its burning wreckage. He made for the nearest of the enemy but, changing his mind on the point of collision, he pressed the twin firing levers on the spade-grip column. The Fokker fell away in flames . . .

The Snipe finally crash-landed behind our lines and Barker was lifted out unconscious. He recovered from his wounds and for his surpassing gallantry was awarded the Victoria Cross.

So much for the fighting qualities of the Snipe and for the sort of men who flew it.

The Snipe continued in service, at home and abroad, until the early 1920s but several other fighters were to materialize in the years between. Chronologically the Snipe's successor was the Dolphin 5 F.1, often remembered as the first Sopwith fighter with a liquid-cooled engine, though this is not strictly true, for two Triplane prototypes had been experimentally fitted with Hispano-Suiza engines, one of 150, the second of 200 h.p. Nevertheless, the Dolphin was notable in being specifically designed for the 200 h.p. geared "Hisso." Even more significant, it had four guns and—to afford the pilot an exceptional field of view, particularly for night fighting—its two-bay wings were staggered backwards. The first Dolphin had a deep car-type radiator, whereas on production machines twin radiators flanked the cockpit. The pilot sat with his head protruding through the top centre-section, but this proved to be a dangerous location in the event of a nose-over, and to minimize the risk protective "hoops" were fitted on the upper wings and an emergency exit was built in the fuselage side.

Mounted on the upper front spar extensions were twin Lewis guns, capable of being manually elevated, and over the engine were the standard twin Vickers.

The Abandoned Cuckoo

Though Sopwith machines up to this time had all displayed some family characteristic, they were by no means stereotyped, and the design which followed the Dolphin was indeed something different, being a large three-bay, single-seater, torpedo-dropper. Latterly known as the Cuckoo (the Sopwith egg having been hatched in the Blackburn nest), it had a chequered career, the story of which is outlined by Rear-Admiral Murray Sueter. The Admiral tells how he invited Mr. Sopwith to the Admiralty to discuss the building of a torpedo-carrying aircraft. "Sopwith was a great constructor," he writes, "and never failed in anything I asked him to undertake. He thought my proposition was very stiff, as it meant building a light aeroplane round the Whitehead torpedo, and he had better think it over."

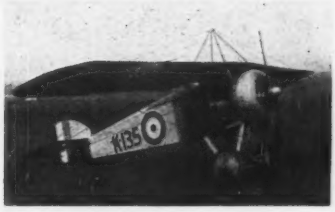
The Admiral confirmed his conversation in a Most Secret memorandum dated October 9th, 1916, asking Mr. Sopwith to study the design of a torpedo-carrying aircraft with four hours' fuel and one or two 1,000 lb torpedoes.

Mr. Sopwith got to work, but when the prototype was nearly ready the Admiral was ordered abroad and interest in the project lapsed. One day W/C. Longmore—the first Englishman to release a torpedo from an aircraft—was visiting the Sopwith works and saw the Cinderella torpedo-carrier triced up to the beams of one of the shops. His questions elicited its history and Longmore had the machine dusted down and prepared for tests. Eventually, impressive quantities were ordered from the Blackburn company—but too late for the Cuckoo to play any useful part in the war.

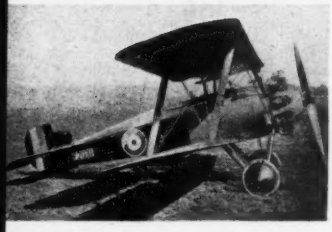
It should not be thought, after this nautical deviation, that the list of Sopwith fighters has been exhausted, for in April, 1918, there appeared the deadly Salamander (TF.2). The name was, indeed, apt, for this machine was a trench strafer, developed from the Snipe and carrying nearly 650 lb of armour plate. This had a structural as well as a protective function, in forming the front of the fuselage from a point immediately behind the engine and extending aft of the pilot's cockpit. The pilot's head was protected and streamlined by a bullet-proof fairing—one of the few recognition features, incidentally, which distinguished the Salamander from the Snipe. Standard armament of the Salamander was two Vickers guns with the unprecedented ammunition supply of 1,000 rounds each. Experimental variants had four, six, and even, it is said, eight guns, the eight being arranged to fire downwards through the floor.

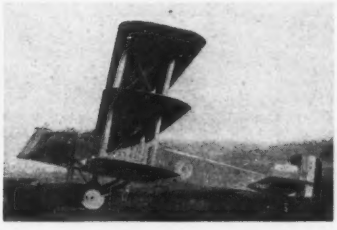
Contemporary with the Salamander was the Buffalo—a two-

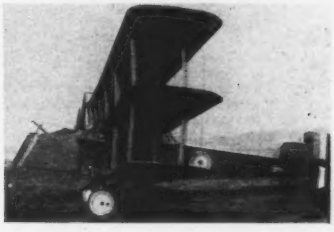
A Sopwith Assortment . . .



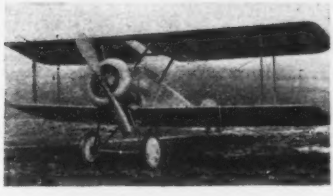
This column, reading down: Snail experimental fighter (180 h.p. A.B.C. Wasp); Swallow experimental fighter (110 h.p. Clerget); Cobham bomber (Siddeley Puma engines); Gnu three-seater; Rainbow racer of 1920, with A.B.C. Dragonfly engine.







Right-hand column, reading down: Snail experimental fighter with monocoque fuselage; Scooter; Snark high-altitude fighter triplane (A.B.C. Dragonfly); Cobham bomber (second prototype, with A.B.C. Dragonfly engines); Dove (single-seater version); Wallaby (for Australia flight); Antelope.



This column, reading down: Dragon (an experimental Snipe development with 360 h.p. A.B.C. Dragonfly); Snapper (A.B.C. Dragonfly); Grasshopper trainer, with 100 h.p. Anzani; Schneider seaplane of 1919, with 450 h.p. Cosmos Jupiter.

FIGHTING BREED . . .

seater designed for "contact patrol" or, in modern parlance, low-level army co-operation, and, like the single-seater, armour-protected. Flight trials were most encouraging and the Buffalo was on the point of being quantity-produced when the Armistice was signed.

It will have been noted that all the basic military types so far considered (other than the Buffalo) were produced in quantity (more than 11,000 in this country and some 5,000 abroad); but in four years of war a number of "one-off" or, perhaps, "two-off," prototypes took the air and, though all were not entirely successful, they are certainly not to be considered as skeletons in the family cupboard. The first was built as early as 1916 and was a large three-seater triplane, intended for reconnaissance and fitted with a 250 h.p. Rolls-Royce engine. Two members of the crew were seated in conventional dignity in the fuselage and a third was perched up in a centrally mounted streamlined nacelle on the top wing. The undercarriage resembled the chassis of a motor bus.

After this nameless wonder there followed, in 1917, that aggressive-sounding pair the Bulldog and Rhino, the Bulldog being a two-seater biplane fighter with two fixed Vickers guns and a pair of Lewises on independent post mountings in the rear cockpit. One version had two-bay wings; a second was single-bay. The Rhino was a two-seater triplane bomber with a 220 h.p. B.H.P. engine, and the nature of the beast may be judged from our photograph. At the other end of the scale, in 1917, came the Bee, or Tadpole, which was essentially a Pup with "sawn-off" wings of only 16ft 3in span, and with an abbreviated fuselage.

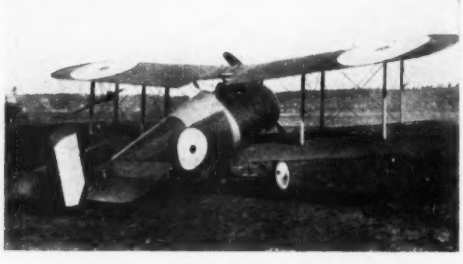
The prototype crop of 1918 was an abundant one : the Clerget-powered Hippo was a two-seater reconnaissance machine with pronounced backward stagger; the Sparrow, a small single-seater biplane fitted with a 30 h.p. A.B.C. Gnat engine and built—nominally for wireless-controlled target experiments, but actually for use as a flying bomb—in conjunction with Professor A. M. Low; and the Snail (180 h.p. A.B.C. Wasp radial) was a fighter, one version of which had a plywood monocoque fuselage.

The B.1 Bomber was a single-seater biplane with 200 h.p. Hispano-Suiza engine and closely related, as its picture suggests, to the torpedo-dropping Cuckoo.

It has already been remarked that Sopwith design was never stereotyped, and in 1918 the company decided to try its hand at a monoplane. A Camel fuselage was wedded with a parasol wing, wire-braced from a central king-post, and the offspring of the union was named the Scooter. Performance was higher than that of the standard Camel though insufficiently high to warrant production. A later, lower-powered version, known as the Swallow, was a favourite aerobatic mount of Harry Hawker.

With this symbolic transformation of a fighting machine for a peaceful pursuit, a new, post-war chapter opens in our Sopwith story; but, with the coming of peace, the production of fighting aircraft did not cease, as witness this paragraph from a 1919 issue of *Flight* : "On June 5th the Prince of Wales drove down to Kingston to inspect the Sopwith Aviation works. He was received at the chief office by Mr. T. O. M. Sopwith; Mr. R. O. Carey, managing director; Mr. H. P. Musgrave, secretary and organizing manager; Mr. L. Fowler, factory superintendent; and Mr. H. Mitchell, works manager. On entering the works he was greeted by the workmen with a hammer chorus. In the metal assembling shop the Prince saw the various processes of making bullet-proof shields for the protection of the low-flying trench-fighting Salamanders, and he also visited the experimental shops. The Prince then drove to the new factory at Ham, where he saw the assembling of aeroplanes and inspected completed Salamanders and Dragons with their fighting equipment. The Prince climbed into the pilot's seat of a Salamander, completed and ready for delivery, and Mr. Sopwith explained its details."

Bentley-powered Snipe (two-bay version, as used by R.A.F.).



Atlantic biplane, used for Hawker's dramatic attempt of 1919.

The Dragon referred to was one of four military types on test in the early post-war period and was a further development of the Snipe, having a 320 h.p. A.B.C. Dragonfly radial engine.

The monocoque form of construction already mentioned in connection with the Snail was similarly a characteristic of the Snark of 1919. Developed specifically for high-altitude fighting, this triplane had an A.B.C. Dragonfly engine and, although it climbed well and had a high ceiling, it was disappointingly slow.

Last of the Sopwith fighters was the Snapper, likewise Dragonfly-powered, but a single-bay biplane of very attractive proportions. It was a fighter in the best Sopwith tradition and its speed of 140 m.p.h. at 3,000ft was not surpassed by standard R.A.F. machines for many years to come. Even so, it was not the fastest of the Kingston-built fighters, for a Snipe, experimentally powered with a Dragonfly, was credited with 156 m.p.h.

The name Sopwith had always been associated with single-engined aircraft; in fact, to many people any small machine was a Sopwith and any big one a Handley Page. But there was one quite large twin-engined Sopwith type—the little-known Cobham bomber of 1919. The engines (in the first instance Siddeley Pumas; later, A.B.C. Dragonflies) were installed in nacelles between the lower planes, and there were Scarff rings for nose and dorsal gunners. The flying weight was 6,300 lb.

After the war the company—now styled the Sopwith Aviation and Engineering Co.—maintained its design and experimental staffs at full strength, and, with high hopes of golden years ahead, got to work on three civil types, in addition to the Grasshopper (Anzani) trainer. Of these three the smallest was the Dove 1/2-seater tourer, based on the Pup and having an 80 h.p. Le Rhone. Many a frustrated private owner today would cherish one of these dainty, sweet-flying little biplanes, for the speed range was 40-100 m.p.h. and there was tankage for 200-250 miles.

Next in size came the Gnu, a three-passenger or freight-carrying biplane with 110 h.p. Le Rhone or 200 h.p. Bentley. The pilot had an open cockpit, but in one version the passengers were roofed in, so that the Gnu was one of the earliest cabin aircraft to be specifically designed for transport flying.

Atlantic Epic

Largest of the civil trio was the projected Rolls-Royce Eagle-engined Transport, which, had it materialized, would have introduced class travel in that four of the passengers were to be enclosed, while the fifth would have sat in the open cockpit with the pilot. So efficient was the design that a version of it was selected to attempt the Atlantic crossing for the *Daily Mail* £10,000 prize.

In the Atlantic, as the contender was known, pilot and navigator were emplaced well aft, allowing a 330-gal tank to be fitted in the fuselage. The designed endurance was 22 hr at 100 m.p.h. Not an inch of space nor an ounce of weight was wasted, and the top of the fuselage could be detached and used as a lifeboat in case of a forced descent.

The Atlantic attempt, with Hawker as pilot and Lt.Cdr. Mackenzie Grieve as navigator, stands as the supreme example of a gallant failure. The take-off from Newfoundland was on May 18th, 1919. As soon as the coast was crossed Hawker jettisoned the undercarriage to gain some 7 m.p.h. in speed, and from that moment the world knew nothing more for seven fateful days. What happened in the meantime was eventually related by Hawker himself. About ten minutes out the Sopwith had met a Newfoundland fog, but climbed above it into a clear sky. After four hours visibility became very bad and dense cloudbanks, a heavy storm and rain squalls were successively encountered; but the heavily laden machine fought on to 15,000ft.

After 5½ hours a choked filter sent up the temperature of the engine-cooling water, but this was rectified by a glide of several thousand feet. Then for a few hours things went well until once again the circulation system choked up, and the temperature of the water rose to boiling point. Hawker knew that until the pipe was cleared he could not climb much higher without using excessive power.

"When we were about 12½ hours on our way," he wrote in the *Daily Mail*, "the circulation system was still giving trouble, and we realized we could not go on using up our motor power. Then it was that we reached the fateful decision to play for safety. We changed course, and began to fly diagonally across the main shipping route for about 2½ hours, when, to our great relief, we

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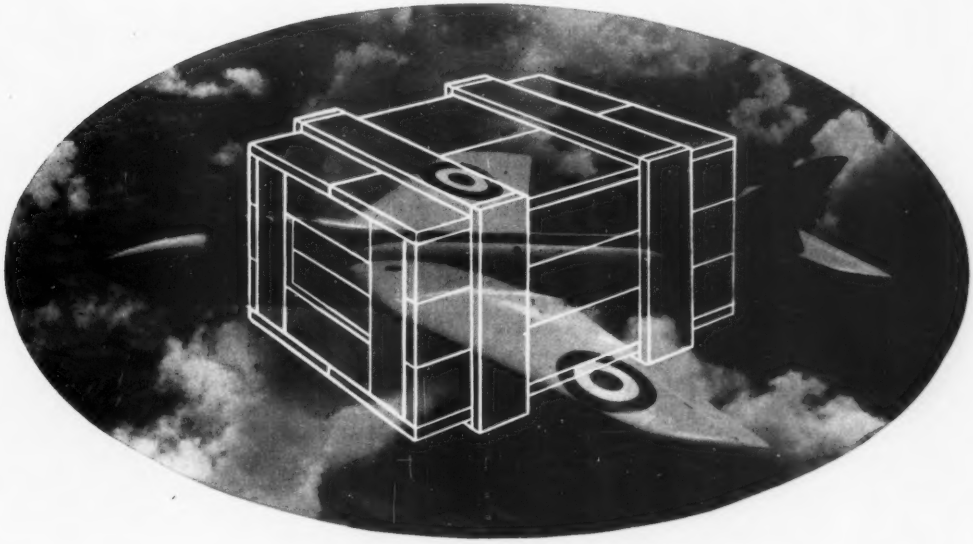

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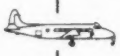
AMBASSADOR



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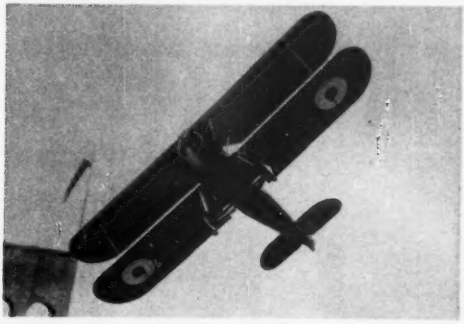
DE HAVILLAND

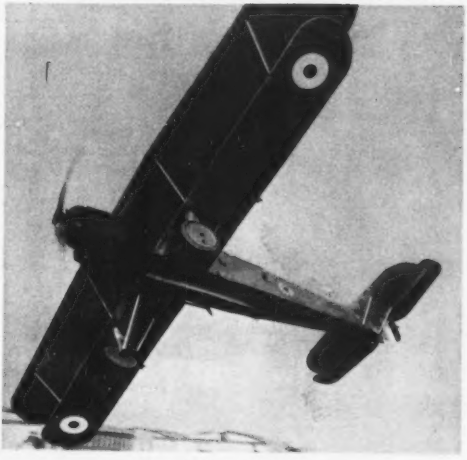
A HAWKER GALLERY

Cygnet (Cherub).

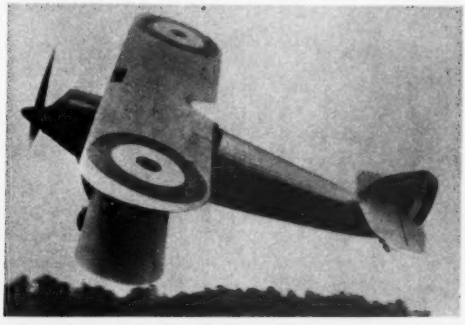
Hedgehog (Jupiter).



Woodcock (Jupiter).



Torpedo Horsley (Condor).



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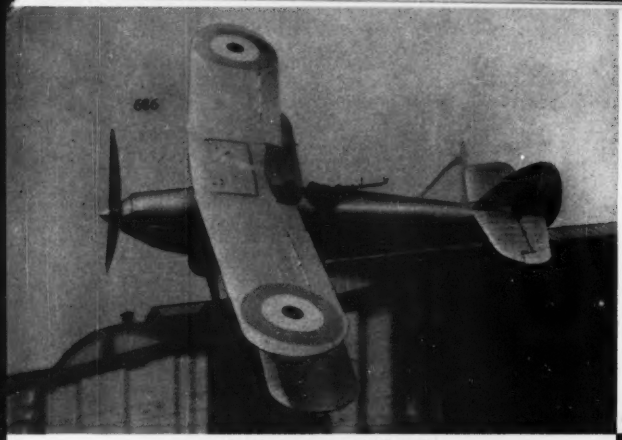
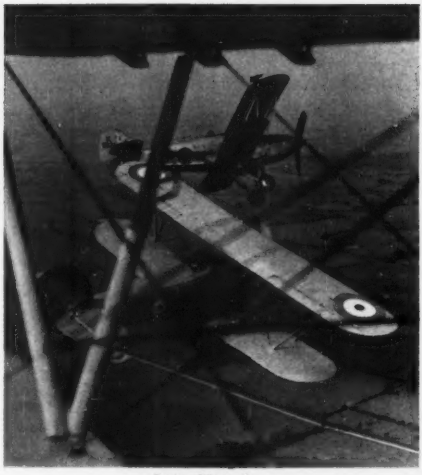
Above: Hornbill (Condor).
Right: Hoopoe (Mercury).
Below: Hawfinch (Jupiter).



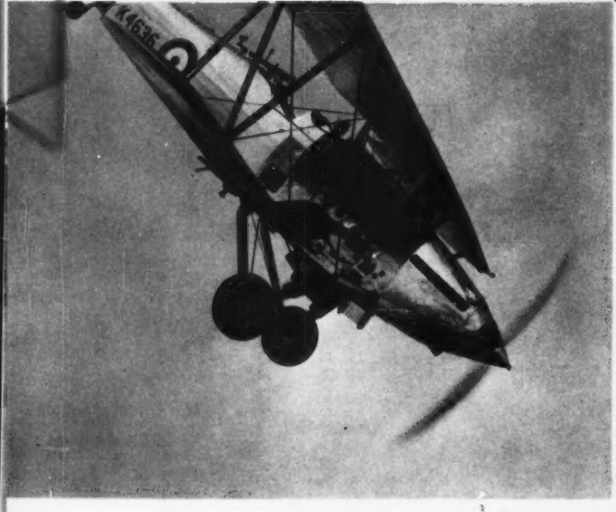
Hart (Osprey prototype) (Kestrel).

Nimrod (Kestrel).

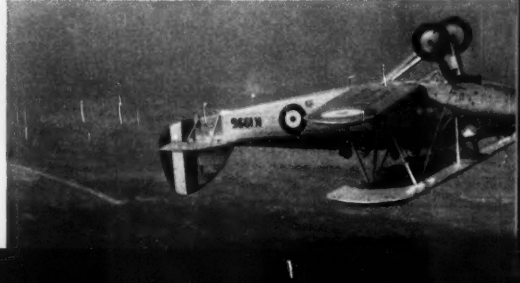


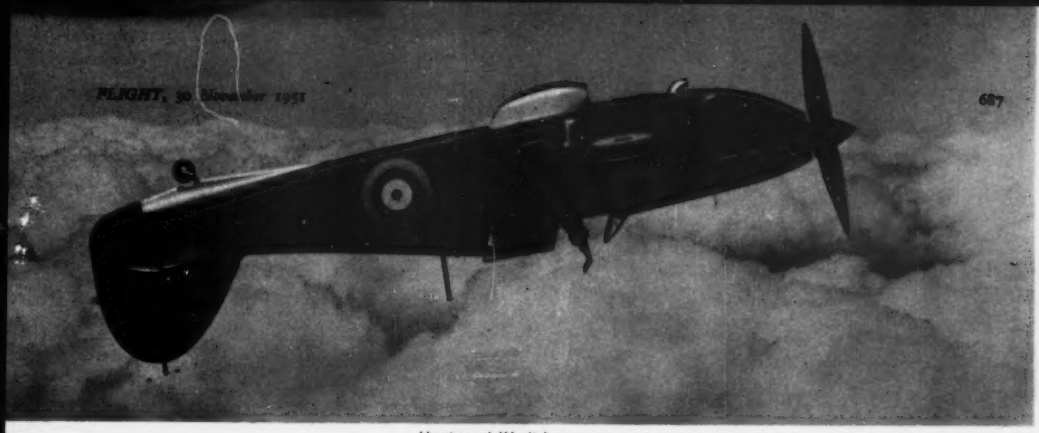
Furies (Kestrel).
Below : Hind (Kestrel).

High-speed Fury II (Goshawk).



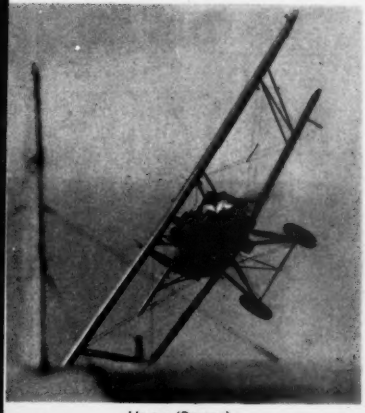
Demon (Kestrel).



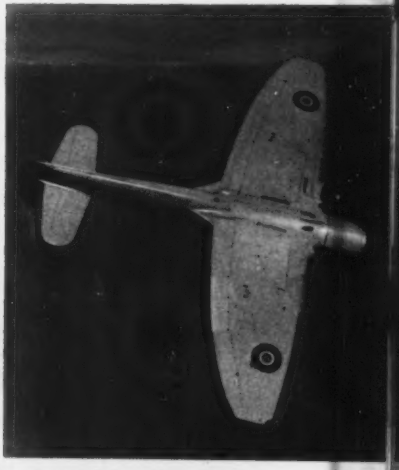


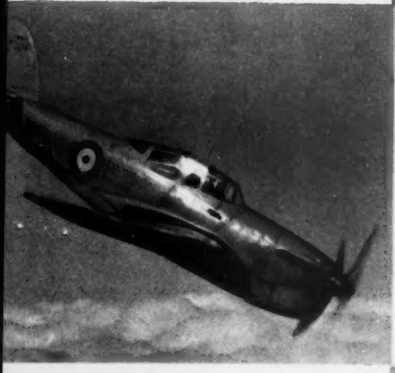
Hurricane I (Merlin).

A HAWKER GALLERY . . .



Hector (Dagger).





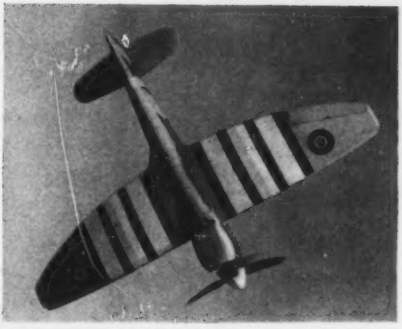
Typhoon 1B (Sabre).

Upper right : Tempest 2 (Centaurus).

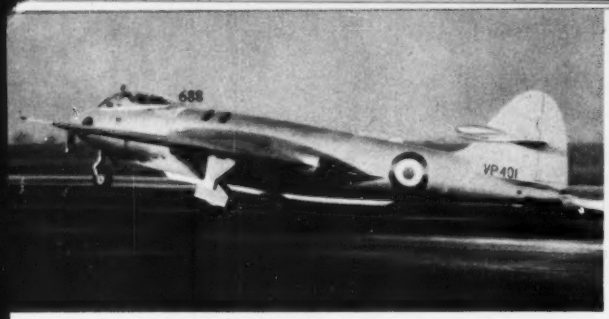
Right : Tempest 5 (Sabre).

Left : Henley (Merlin).

Below : Sea Fury 11 (Centaurus).



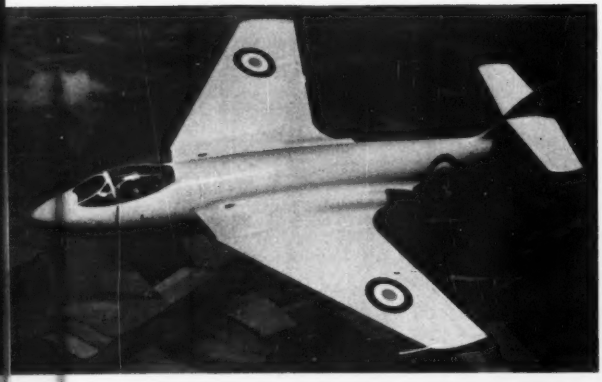
Left: Hart Trainer (Kestrel).



P.1072 (Nene turbojet and Snarler rocket).

Sea Hawk F.1 prototype (Nene).

A HAWKER GALLERY . . .



Above : P.1052 (Nene).

Above, right : P.1081 (Nene).

Right : P.1067 (Avon).

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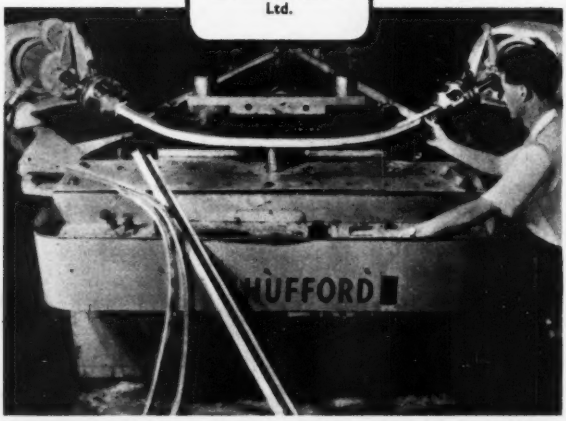
Hawker Sea Fury and Sea Hawk production. Photographs by courtesy of Hawker Aircraft Ltd.



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FIGHTING BREED . . .

sighted the Danish steamer, which proved to be the tramp *Mary*. We at once sent up our Very light distress signals. These were answered promptly, and then we flew on about two miles and landed in the water ahead of the steamer.

"The sea was exceedingly rough, and, despite the utmost efforts of the Danish crew, it was an hour and a half before they succeeded in taking us on. It was only at great risk to themselves, in fact, that they eventually succeeded in launching a small boat, owing to the heavy gale from the north-east which was raging . . ."

The rescue was made 14½ hours after the Atlantic left Newfoundland, but the *Mary* carried no wireless, and it was not until she arrived off the Butt of Lewis a week later that the world was told.

Profiting from experience with the Atlantic machine, the company got to work on a further development, intended for a flight to Australia by Capt. Matthews and Sgt. Tom Kay. But even the name Wallaby brought this fine-looking biplane no luck, for Capt. Matthews' arrest in Yugoslavia (where he was mistaken for a Bolshevik), a cracked cylinder, a crash-landing at the entrance to the Persian Gulf, a damaged undercarriage, a broken airscrew, and—only 1,100 miles short of Australia—a final write-off, intervened.

There were many features of interest in the Wallaby, notably the retractable seats, which allowed the crew to be completely enclosed except when clear forward vision was necessary. The Wallaby, incidentally, was probably the only aircraft with two rudder bars for the pilot—the second corresponding to the high position of the seat.

Resolved to repeat the historic Schneider success of Howard Pixton, the company turned out a very fast and handsome racing seaplane for the 1919 contest. The cylinders of the 450 h.p. Cosmos Jupiter were carefully faired, and the fuselage was of excellent aerodynamic form. A slight backward stagger characterized the 24ft single-bay wings and the lower part of the rudder was made very thick to serve as a tail float. For various deplorable reasons the race was declared void.

A landplane version, called the Rainbow, was flown by Hawker in the Aerial Derby of 1920. No Jupiter being available, a 320 h.p. Dragonfly was installed and the saving in weight allowed a slight reduction in wing span. Misunderstanding the rules, Hawker did not cross the finishing line in the manner laid down and was disqualified.

The last machine to bear the name Sopwith was a commercial type—the Antelope—which seated two passengers in a cabin, with side-entry door, in addition to the pilot. Among other appealing features it boasted a self-starter for the Wolseley Viper engine. In the Air Ministry Competition at Martlesham in 1920 the Antelope carried off the second prize of £3,000 after a neck-and-neck contest with the Westland Limousine.

Unhappily, the enterprise of the company in developing the fine civil machines described availed it little, and production of A.B.C. motor cycles, toys and domestic utensils failed to justify deferment of voluntary liquidation, which was notified in September, 1920. But the company was not long in limbo and was resurrected in November under the title H. G. Hawker Engineering Co., Ltd.

Flight expressed its sentiments as follows: "In hailing the arrival of the Hawker Engineering Co., Ltd., into the ranks of British Aircraft we feel that we are really welcoming the re-entry of one of the pioneer British firms, and that the new company has stepped in to take up the threads where the now defunct Sopwith Aviation Co. left off. With Fred Sigrist as managing director, and Mr. Sopwith, Maj. Eyre, Mr. Bennett and Capt. Peaty on the board of directors, the firm should worthily uphold the tradition of the old Sopwith Co."

In July, 1921, Harry Hawker—by this time still only 31 years old—met his death in a Nieuport Goshawk which he was testing prior to racing it in the Aerial Derby. Of him somebody wrote, "He began where others left off," and from His Majesty King George V came the message: "The nation has lost one of its most distinguished airmen, who by his skill and daring has contributed so much to the success of British aviation."

Production by the new company was initially concentrated on the two-stroke Hawker motor cycle and on special aluminium bodywork; but the old hands were already hankering after the air and were not content until 1923, when the company turned once more to aircraft construction.

The Hawker company's first aeronautical venture (1923) was a "corps reconnaissance" machine rejoicing in the name of Duiker (a high-speed antelope, pronounced, we aver in our wisdom—having had recourse to sundry works of reference—"Diker"). It was, remarkably enough, a swept-back parasol-wing monoplane and it was built to the designs of Major Thompson. Though it did not achieve fame for itself, it was notable in that exacting army co-operation requirements were met.

Though contemporary documents and publications often described the early Hawker machines as "Sopwith/Hawker," the only design to which this appellation could strictly be applied was the rebuilt 1919 Jupiter-engined Schneider racer which, with land undercarriage, was flown into second place in the 1923 Aerial Derby by F/L. Longton, at 165 m.p.h.

Mr. Carter's Woodcock

The first truly Hawker fighter was the Woodcock, to the designs of Mr. W. G. Carter (now technical director, Gloster Aircraft), who had joined Sopwiths in 1916 as chief draughtsman. The first Woodcock was a two-bay biplane, Jaguar-powered, and having variable-camber flaps, but in the "new and experimental" park at the R.A.F. Pageant of 1924 appeared the Mk 2, much cleaned up, with single-bay wings, repositioned guns and something quite new in the form of "helmets" over the cylinders of its Jupiter engine. A feature of both Woodcock prototypes was the wide-track undercarriage, and this feature was to be especially appreciated by R.A.F. pilots when the type—with uncowled Jupiter—was adopted as the standard R.A.F. night fighter.

Without disparagement it may be remarked that the character of this fighter was discernible to a marked extent in a machine for vastly different duties, namely, the three-seater Fleet-reconnaissance Hedgehog, first flown with land undercarriage and later fitted with combined wheel-and-float gear. Folding wings with camber-changing flaps, three separate cockpits (the third with Scarff gun ring), and axle-mounted arrester hooks characterized this deck-landing biplane.

It was during the period of Woodcock and Hedgehog development that Sydney Camm joined the Hawker design staff.

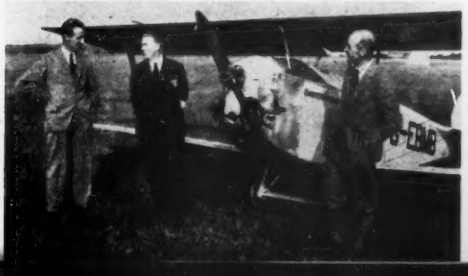
Through the medium of flying models, Camm had been an assiduous student of aerodynamics and aircraft construction, and this had led to his founding the Windsor Model Aeroplane Club and constructing a man-carrying glider. Shortly before the First World War he had started his professional career in the Martinsyde shops, where his diligence and imaginative approach to structural problems earned him promotion to the design office.

The first Hawker project with which Mr. Camm was associated (in conjunction with Mr. Carter, who was still chief designer, and Mr. George Cornwall) was the little Cygnet two-seater light biplane, and in this exquisitely built machine his constructional skill had full scope. Empty the Cygnet weighed 373 lb; laden, 950 lb—figures which, as Major (later Sir John) Buchanan pointed out before the Royal Aeronautical Society at the time, were strikingly indicative of what could be done by close attention to detail.

Two Cygnets, piloted by F/L. Longton and F. P. Raynham (the company's chief test pilot before the arrival of F/L. P. W. S. Bulman, M.C., A.F.C.) were entered for the Light Aeroplane Competitions in 1924. In the Duke of Sutherland's contest for the best take-off and pull-up Raynham carried off the £100 prize, while Longton put up the best performance in the landing trials.

The Duiker reconnaissance monoplane, above, was the first truly Hawker design. It was powered by a Bristol Jupiter.

Below, at Lympne in 1926, are the Cygnet (British Anzani) and (left to right) Sydney Camm, H. K. Jones and that great Hawker test pilot, F/L. (now G/C.) P. W. S. ("George") Bulman.



The Heron (Jupiter) of 1926. Speed: 160 m.p.h. at 10,000ft.

FIGHTING BREED . . .

The delightful little Tomtit trainer (Mongoose) of 1929.

During the following year a Cygnet flown by F/L. Bulman (who, for many years to come, was to flight-test every one of Mr. Camm's prototypes) won the 100-mile international handicap race at 74 m.p.h. and gained other distinctions, and in 1926 a pair of Cygnets participated in the *Daily Mail* competition for light two-seaters. The first, entered by Mr. Sopwith and Mr. Sigrist, was flown by Bulman and the second, sponsored by the R.A.E. Flying Club, was in the hands of F/L. Chick and F/O. Ragg. Both machines had a Bristol Cherub 3 engine. Bulman proved the winner, averaging 65 m.p.h. over 1,944 miles, and the other Cygnet was placed second. The average fuel consumption was 39 m.p.g.

Cygnets were flown with the A.B.C. Scorpion and inverted-vee-twin Anzani engine, but the sole remaining example (which, in the hands of Hawker test pilot Frank Murphy, has charmed a number of post-war flying assemblies) has a Cherub.

During 1925 Woodcock production went ahead and in August of that year Mr. (now Sir Frank) Spriggs joined the board of directors, where he was able to cultivate those qualities which ultimately won him the managing directorship of the great Hawker Siddeley Group. He had joined Sopwiths in 1913.

In 1926 Mr. Camm, who had been appointed chief designer during the previous year, undertook a redesign of the Woodcock to meet the requirements of the Royal Danish Naval Air Service. The span of the bottom mainplanes was reduced, the interplane struts were raked, and a two-row Armstrong Siddeley Jaguar engine was installed in place of the Jupiter, allowing a reduction in fuselage cross-section. Six machines, known as Danecocks, were ordered and the first three were delivered only five months after the redesign was put in hand. This order, incidentally, was the forerunner of numerous foreign contracts of major size.

Greater achievements than the Danecock were to mark the year 1926, for this was the period of the Hornbill, Heron and Horsley, each, in its own field, a significant advance.

The Hornbill was an intercepter, literally built round the 700 h.p. Rolls-Royce Condor engine—at that date the most powerful ever installed in a fighter. As demonstrated by F/L. Bulman at the R.A.F. Display in 1926, the Hornbill's flying qualities were as remarkable as its performance. The top speed fell only 4 m.p.h. short of the magic 200 m.p.h. for which designers were striving.

Metal Construction

The trim little Heron (to Mr. Carter's design) had a Jupiter engine, and was notable in that it introduced a new form of metal fuselage construction, standardized, in its principles, for all subsequent Hawker types up to the Tempest. The longerons and struts of the fuselage were square metal tubes and the whole structure was braced by high-tensile wires and proved remarkably light and rigid.

After the Woodcock and Danecock the next Hawker type to be built in quantity was the Horsley, a sturdy Condor-engined biplane of unequal span, which, in its little-known Mk I form, differed from its Mk II successors in that there was no sweepback on the upper wings and in having lateral radiators. The Horsley was first flown by Raynham, with Mr. Camm in the back seat, and after initial difficulties proved to be one of those designs naturally suited for development and adaptation. There was, for instance, a seaplane version, with four-blade airscrew and duralumin floats; an experimental variant with the 800-h.p. Armstrong Siddeley Leopard engine; another with a Condor compression ignition engine, and—even later—a Rolls-Royce Buzzard. The early machines were of composite construction but an all-metal structure, to Mr. Camm's design, was later standardized. It is significant that six years after its inception the Leopard-Horsley was adopted by the Danish Government and re-named the Dantorp; it was manufactured in the Royal Naval Dockyard at Copenhagen and was employed both as a landplane and seaplane. The Condor-Horsley was adopted by the Greek Naval Air Service.

In the R.A.F. the Horsley served not only as a day bomber but as a coastal defence torpedo/bomber, and such were its qualities of endurance and carrying capacity that it was an obvious choice for an attempt on the world's long-distance record, then held by the Frenchman Costes, with a 3,390-mile flight from Paris to Jask, Persia.

The original Horsley had an all-up weight of 7,800 lb, but Mr. Camm and his staff calculated that the airframe was strong enough to permit loading to 14,200 lb. The retanking of the long-distance Horsley recalled Sopwith's efforts with their Atlantic machine: three tanks were housed in the fuselage, two in the top centre-section and one in each of the top outer mainplanes. A special high-compression Condor was installed, the undercarriage was strengthened and, as the main fuselage tank was enlarged, the cockpits were moved aft.

The selected pilot and navigator were F/L.s Carr and Gillman. A tyre-burst, as the machine was wheeled from its hangar, was not a happy augury, but on May 20th, 1927, the big biplane took off from Cranwell, in a veering wind, after a run of 792 yards. For two days there was no news; then it was learned that the Horsley had "ditched" in the Persian Gulf, after being airborne for 34½ hr. and covering a straight-line distance of 3,420 miles. This unofficial record was to stand only for 2 hr—until Lindbergh landed at Paris after his 3,590-mile transatlantic flight.

Without delay further preparations were put in hand but no success attended them, and finally, on June 18th, 1927, a third and last attempt was made. The machine was escorted at the outset by a second Horsley, flown by F/L. Bulman and with *Flight*'s John Yoxall in the rear cockpit. Yoxall recalls how, as the pair approached Ipswich, he saw a tell-tale stream of oil leaving the cowling of Carr's machine. It was, of course, still very heavily overloaded, and, rather than risk disaster in attempting a landing, Carr and his navigator, Mackworth, had been instructed to take to their parachutes in such an event. Nevertheless, the Horsley was set down on the rough surface of Martlesham Heath in a perfect landing.

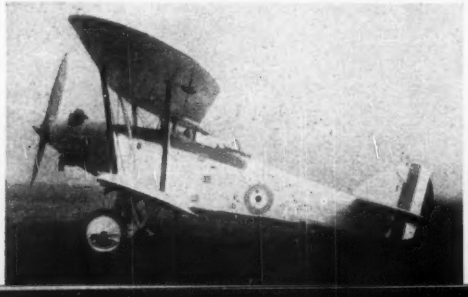
The year 1927 saw Mr. Camm at work on designs for a new fighter to replace the ageing Siskin in R.A.F. squadrons and the outcome was the Hawfinch—a Jupiter-engined biplane tested with both single- and two-bay wing cellules. When the supercharged Jupiter VII was installed the new fighter was flown by "George" Bulman at 171 m.p.h. at 9,850ft. Handling qualities were excellent and hopes for a contract ran high. The choice of several competitive designs was finally narrowed down to the Hawfinch and the Bristol Bulldog, and specimens of both types were sent to the squadrons for protracted trials under operational conditions. It would be pleasing here to record a Hawker victory; but this was not to be, for the Bulldog was ultimately declared the winner. This success of worthy rivals was ungrudgingly acclaimed by the Hawker team as they quietly went ahead with new projects.

The Hawfinch, incidentally, was one of those prototypes which is able to earn its keep before being relegated to the scrap heap. At one stage it was adapted for the testing of an "anti-stall" wing, having a normal section between the root and mid-aileron, and a thickened, heavily cambered, section outboard to the tip. By this means lateral control at low speeds was increased, though there was a penalty in the form of high tip loads at top speed.

During 1929 two new designs were taking shape at Kingston, the first for a high-altitude bomber, which materialized as the Harrier; the second, for a trainer, destined to make a name for itself as the Tomtit. Initially powered with a geared Jupiter VIII, the Harrier was developed for torpedo-carrying as well as bombing, the "tin fish" reducing the top speed of 136 m.p.h. by some 9 m.p.h. Experimentally, a Bristol Mercury was installed, and the same airframe was selected as a flying test-bed for the "hush-hush" Bristol Hydra 16-cylinder double-octagon radial.

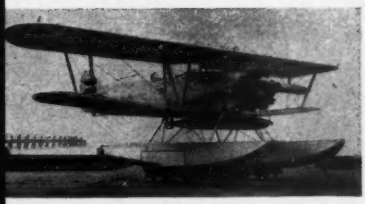
The Tomtit was an altogether delightful little single-bay biplane,

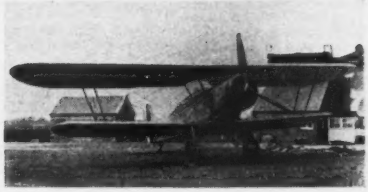
Harrier high-altitude bomber or torpedo aircraft (geared Jupiter).



A Pegasus-powered private-venture dive-bomber—the P.V.4 of 1935.

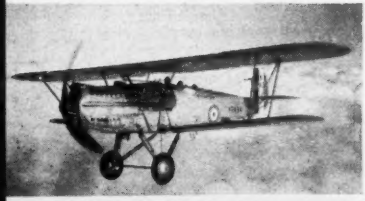
Hawker Biplanes . . .

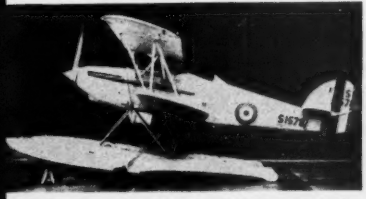


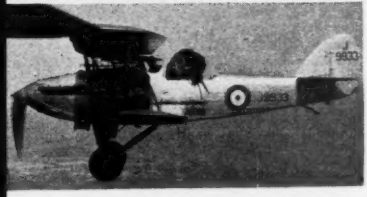


Left-hand column, reading down: Dantorp seaplane (Leopard); the original Hornet (Kestrel); Audax (Kestrel); Dagger-Hart (prototype for Hector); Nimrod floatplane (Kestrel); Demon with Frazer Nash (Parnall) turret (Kestrel); Yugoslav Fury (Kestrel).

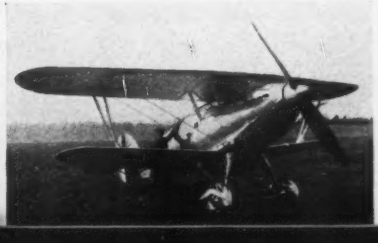
This column, reading down: Woodcock I (Jupiter); single-bay Hawfinch (Jupiter); Harrier (Hydra test-bed); Osprey floatplane (Kestrel); Hart test-bed for P.V.12 (Merlin); High Speed Fury I (Kestrel).







Right-hand column, reading down: Danecock (a redesigned Woodcock with Jaguar engine; F.20/27 interceptor (Mercury)—the forerunner of the Hornet and Fury; single-bay Hoopoe (Panther)—forerunner of the Nimrod; Swedish Hart (Pegasus); Osprey with experimental central-float undercarriage (Kestrel); experimental Hart fighter (later Demon) with protected cockpits (Kestrel); Fury II (Kestrel); High Speed Fury II (Goshawk).



FIGHTING BREED . . .

originally powered with an Armstrong Siddeley Mongoose, but later adapted for the Cirrus Hermes and Wolseley radial engines. Only a few were supplied to the R.A.F. but the type was adopted by the Canadian Department of National Defence as a standard trainer for the R.C.A.F. Tomtits were familiar at pre-war races and one was often to be seen at Northolt with the Prince of Wales at the controls. The sole remaining example is a favourite demonstration mount of Neville Duke (now chief test pilot) and, static or airborne, continues to delight the eye at week-end gatherings.

During the period 1927-29 the Air Staff was concerning itself very closely with fast-climbing home-defence intercepter fighters, and, to meet the requirements laid down in Specification F.20/27, Hawkers turned out a Mercury-powered single-bay biplane of notably clean design. Performance was most gratifying and a speed of 210 m.p.h. was recorded at 10,000ft.

In this fighter may be seen the connecting link between the Hawfinch and Hornet. The latter was eventually to achieve fame as the Fury, and was a Rolls-Royce-engined development, first seen in public at the Olympia Exhibition of 1929 in company with the Hart two-seater. It was acclaimed as the world's fastest fighter.

With the Hornet and Hart a splendid new chapter opens in the Hawker story—a story of international successes, mounting orders and brilliant technical development, the whole of it centring on these two shapely and amazingly adaptable biplanes.

In tracing the evolution of the Fury and Hart it is necessary to examine each type in somewhat greater detail than hitherto. The Fury, as we have remarked, was a direct development of the radial-engined F.20/27 and the basic design is best seen in the Fury I, as supplied to the R.A.F. in 1930. The Fury I was a single-bay biplane of unequal span. The constant-chord wings had metal spars and spruce ribs, and ailerons were fitted on the top wings only. A rectangular, all-metal structure, the fuselage was faired to oval section, and was covered forward with quickly detachable cowling and aft with fabric. The cross-axle undercarriage had oleo-cum-rubber shock absorbers. Two synchronized Vickers guns, supplied with 1,200 rounds, were mounted under the top decking and fired through troughs in the cowling.

Super Furies

The next major step (1933) was the transformation of the Fury I into the High Speed Fury Mk I, or Super Fury as it was often known, which incorporated tapered wings of 29ft 6in span (the original wings were of 30ft span), braced by V-struts. The engine was a special Rolls-Royce Kestrel VI and as part of a general cleaning-up process "spats" were fitted over the wheels. The result was a top speed of 240 m.p.h. and a climb to 20,000ft of 7 min 40 sec.

Two years later appeared another spectacular Fury variant, designated High Speed Fury Mk 2 and having a Rolls-Royce Goshawk III engine with evaporative cooling. Reversion was made to the original style of N-strut bracing, but the wings were unusual in that the upper ones were of constant chord, whereas the lower ones were tapered in plan. Disposed along the leading edges of the upper wings were seven steam condensers, the object of which was the avoidance of radiator drag by using the latent heat, resulting from the evaporation of the cooling water into steam, to radiate engine heat. At top speed results were satisfactory, but the rate of heat dissipation on the climb was inadequate until a small retractable radiator was incorporated. Eventually it was found that the area available for surface condensers was too small and this consideration, combined with other factors, caused the system to be abandoned.

The two "High Speed" developments described were distinct offshoots from the basic Fury, which itself continued in production without interruption, though in various forms and with a variety of power plants. Typical were the Panther-engined Fury for Norway (built under licence in the Army aircraft factory at Kjeller); the Spanish Fury, with Hispano-Suiza 12Xbrs; and the Pratt and Whitney version for Persia. Fastest of the export models was the Yugoslav Fury, with Kestrel XVI engine, low-drag radiator and cantilever under-carriage, incorporating internally sprung wheels. The top speed was fully 250 m.p.h. at 19,500ft.

In succession to the Fury I, the R.A F adopted a Mk II version (Kestrel XVI) in 1935. This was characterized by a composite steam-and-water-cooling system which had been developed on the Hawker company's own Fury, G-ABSE—a "hack," incidentally, with which much useful development work was undertaken.

We may digress from our purely technical consideration to recall the Fury in its hey-day. It will always be remembered, in this country at least, as a pert little silver biplane with brilliantly burnished cowlings and with fuselage and wings made gay by colourful insignia. It sat on the ground at a sharp angle which made it seem eager to get airborne, and the Kestrel gave out a note which added a thrill to any aerobatic performance. And what Fury aerobatics are remembered from the Hendon Displays! An extract from our 1934 R.A.F. Display report, referring to synchronized flight aerobatics by No. 43 Squadron, speaks for itself: "Last year the manoeuvre of rolling in flight formation was carried out for the first time, and it has lost none of its capacity for astounding the onlooker. A neat roll by itself is difficult enough; to roll while watching the flight leader's wingtips, while keeping formation, and while passing either over or under him at the moment when the machine is being held up by rudder is more than astounding; but to carry out the entire manoeuvre in time with another flight doing the same thing . . . that becomes a miracle of practice and efficiency . . ."

The ultimate development of the Fury biplane was the larger, four-gun, P.V.3; but the weight of this day and night fighter had risen to 4,670 lb and in character the machine differed so drastically from the dainty original that the name Interim Fury seemed hardly appropriate.

As the Fury was descended from the F.20/27, so the Nimrod, its Naval counterpart, claimed kinship with an earlier Hawker Fleet fighter known as the Hoopoe, and itself related to the Hawfinch. The Hoopoe was flown both as a single and a two-bay biplane, and at various stages of development was powered with a Bristol Mercury, Armstrong Siddeley Jaguar and Armstrong Siddeley Panther engine.

The Kestrel-engined Nimrod was larger than the Fury, the span being 33ft 6in, and the naval equipment specified (including flotation boxes in the wings and fuselage) brought the gross weight to 3,870 lb. In one variant the airframe was built of stainless steel.

The Nimrod remained as our standard single-seater Fleet fighter until the introduction of the Gloster Sea Gladiator, and several machines of the type were exported. In 1932 the Japanese Imperial Naval Service made arrangements to build Nimrods under licence and the testing of these was the responsibility of F/L. P. G. Lucas, who had resigned from the Fleet Air Arm to become a Hawker test pilot, and who was to play a distinguished part in development flying for several years to come.

So much, then, for the celebrated Hawker single-seater biplanes. Still more remarkable, in the extent of their adoption, were the two-seater Hart and its derivatives, and to these we now turn.

The Hart was designed to meet an Air Ministry specification of 1926 calling for a fast, two-seater day bomber. A Rolls-Royce Falcon was at first envisaged, but later the Rolls-Royce F.XIB (Kestrel) was selected, and with this engine the prototype was first flown by F/L. Bulman in June, 1928.

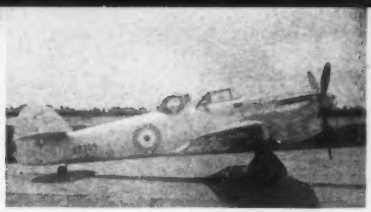
A point which merited much comment when the Hart was shown at Olympia was the form of the wing spar, which had been developed by Mr. Camm and consisted of top and bottom booms of rolled steel strip connected—"dumb-bell" style—by a light plate web. Great strength and stability were obtained for light weight as all material was functioning near its permissible stress at the full factored load.

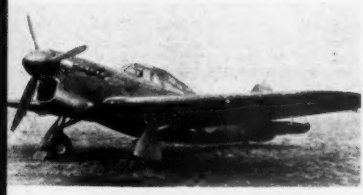
From the outset the Hart was found to be extraordinarily manoeuvrable, and a two-seater fighter version, with fully supercharged Kestrel and twin front guns, was soon ordered for the R.A.F. and given the name Demon. In this fighter the rear cockpit was cut away and the gun ring tilted to facilitate firing at ground targets. The fierce airstream at speeds of 180 m.p.h. and above heavily taxed the physical powers of the gunner and various forms of protective enclosure were tried. Finally a Frazer-Nash (Parnall) hydraulic turret, with "lobster claw" shield, was adopted with great benefit, as the writer can attest, having been privileged to fly in the "Turret Demon" prototype while it was undergoing its Martlesham tests.

In conformity with Specification O.22/26, with folding wings and a medium supercharged Kestrel, the Hart became the deck-landing Osprey. Machines of this type were built with central and twin-float undercarriages and stainless-steel structures. Special equipment, including a message pick-up hook, distinguished the army co-operation Audax, and from this variant, in 1936, was developed the Napier Dagger-engined Hector. With a fully supercharged Kestrel V engine, Demon-type rear cockpit, and other improvements, the Hart became the Hind day bomber, and of both Hart and Hind there were dual-control trainer variants. The South African Government adopted the Hartbees, which was similar to the Hind and could be used for fighting, bombing, or

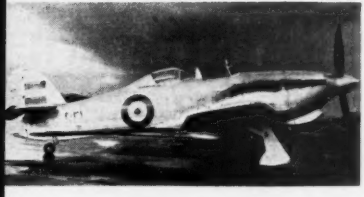
The four-gun, Goshawk-engined P.V.3 of 1935—a Fury development.

Hawker Monoplanes . . .



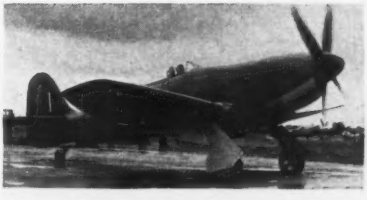


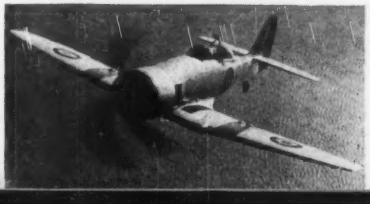
This column, reading down: Henley (test-bed for Vulture); Hurricane V (Merlin); Tornado prototype (Centaurus), first version; first prototype Tempest (Sabre); experimental Tempest (Sabre) with Napier annular radiator; Fury prototype with Griffon.

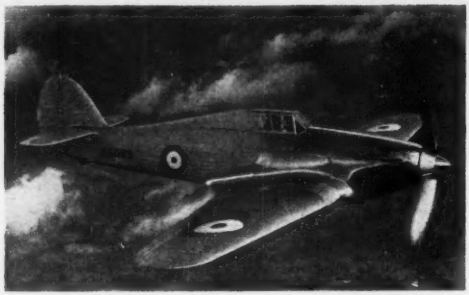


This column, reading down: Hotspur (Merlin); Hurricane IIA with long-range tanks (Merlin); Hawker/Hillson slip-wing Hurricane (Merlin); first prototype Tornado (Vulture); first prototype Tempest (Sabre); first prototype Fury monoplane (Sabre); Sea Fury T.21.

This column, reading down: Henley (test-bed for Griffon); Sea Hurricane (Merlin); Hurricane trainer for Iran (Merlin); Tornado prototype (Centaurus), second version; Typhoon IB with R.P. installation (Sabre); Fury monoplane (second prototype, with Centaurus).







Hawker's first monoplane fighter: the Hurricane, pilot P. W. S. Bulman.

FIGHTING BREED . . .

(having armour plate on the engine, side panels, under-fuselage and wings) for ground attack.

To meet foreign contracts, or for experimental purposes, numerous types of engine were installed in Hart derivatives, including Kestrels of several series, the Pratt and Whitney Hornet, Bristol Mercury, Pegasus and Perseus, Armstrong Siddeley Panther, Napier Dagger, and even the Rolls-Royce P.V.12, the prototype of the Merlin. The P.V.12 Hart, incidentally, was flown at Hucknall by Capt. R. T. Shepherd, for a total of 60 hours and, as our photograph shows, had a four-bladed airscrew.

Production of Harts and Hart variants amounted to 2,201 aircraft, made up of 544 Hart bombers and trainers, 528 Hinds, 414 Audaxes, 135 Ospreys, 190 Demons, 48 Hardys (the Hardy was a general-purpose variant closely resembling the Audax), 178 Hectors, 162 machines of various models to foreign contracts, and two civil Harts, the famous G-ABMR—still in flying trim today—and G-ABTN. The original Hart, registered J9052 (and, it may be noted, modified as the prototype Osprey) survived a mishap with a warship at Buenos Aires, only to become a total write-off in taking off from Brooklands.

Superficially resembling the Pegasus-Hart (though, in fact, differing in numerous respects from the basic Hart design), the P.V.4 dive-bomber was built in 1935 as a private venture to Specification G.4/31. The engine—a Pegasus X, of 920 h.p.—was the most powerful single-row radial then available, and for alternative employment as a level bomber the new machine had a prone sighting position, as in the Hart. But, though the P.V.4 had an excellent all-round performance, it was not ordered in quantity.

Before passing on to the next great phase of Hawker technical development—greater even than that just reviewed—it must be recorded that on May 18th, 1933, the H. G. Hawker Engineering Co., Ltd., was incorporated as a public company and became Hawker Aircraft, Ltd. The first directors were Mr. Sopwith (chairman and joint managing director), Mr. Sigrist (joint managing director), Mr. Frank Spriggs (general manager), and Mr. Bennett (chief engineer). Later they were joined on the board by Mr. Camm, F/L. Bulman, Mr. H. Chandler, Mr. R. W. Sutton and Mr. H. K. Jones. Early in 1934 Hawker Aircraft, Ltd., took over the Gloster Aircraft Co., Ltd.

Though heavily committed at this time to Hart and Fury variants, Mr. Camm and his staff were not unmindful of future requirements and foresaw that a substantial increase in the speed of fighters was the most pressing need. Accordingly, rough designs were drawn up for a monoplane, provisionally known in the Kingston "D.O." as the Fury Monoplane, but destined to develop into the most famous Hawker of all—the immortal Hurricane.

As originally schemed the Fury Monoplane was to have a fixed undercarriage and four guns, two in the fuselage and two in the wings. At that time a Goshawk engine was intended, but as the design study progressed and the Merlin came into the picture, the geometry began to diverge so sharply from the Fury's that the name "Intercepter Monoplane" gained currency.

In January, 1935, Air Ministry representatives were inspecting a full-scale mock-up at Kingston and their deliberations led to the drawing up of Specification F.36/34, to meet the requirements of which a contract for "one high-speed monoplane, K5083" was placed. As work went ahead the contract was amended to include the unprecedented armament of eight 0.303in wing-mounted Browning guns, and when, after being 11 months under construction, K5083 was delivered to Brooklands for flight trials, provision for this load had been made.

The first flight was on November 6th, 1935, and "George" Bulman, in his fashion, enthused. When the first pictures were released the Hurricane was seen to be a clean-cut low-wing cantilever monoplane, with a parallel centre-section and tapered outer panels. The wing was a two-spar metal structure with metal-covered leading edge, the remainder being fabric-covered. The fuselage—a rigidly braced structure of steel and aluminium-alloy tubing—was likewise fabric-covered for the greater part. This adherence to fabric was noted by many technicians with some surprise and—in view of the Hurricane's known performance—misgivings. But the Kingston technicians knew what they were about and had firmly secured the fabric by a most ingenious method: the former-ribs were of rolled channel section and the fabric was attached to them by additional channels screwed into the troughs of the rib-channels, fabric strips being doped over each rib to give a smooth surface.

The retractable undercarriage was the first of Hawker design and incorporated Dowty shock-absorbers and rams, and Dunlop wheels and hydraulic brakes. From the outset it worked like a charm. The pilot's canopy was arranged to slide rearwards and had a quick release for emergency exit. Service equipment included night-flying gear, with landing lights in the leading edges of the wings, oxygen, radio, and flare tubes. The Rolls-Royce Merlin I engine drove a fixed-pitch wooden airscrew, and was fed by two main fuel tanks in the centre-section. There was a ducted radiator under the fuselage, below the cockpit.

Initial trials were so encouraging that the Hawker directors felt justified in tooling-up and ordering material for "1,000 off"; but none could have foreseen that more than 14 times that number would ultimately be built.

The first production Hurricane (L1547) was delayed by changes necessitated by the adoption of the Merlin II and was first flown on October 12th, 1937. Development went ahead and before long a fin was added under the fuselage to improve the spinning characteristics and fair the tailwheel.

The first squadron to be equipped was No. 111, at Northolt, and the C.O.—S/L. Gillan—soon made the headlines by flying his Hurricane from Edinburgh to Northolt at an average speed of 408 m.p.h. A stiff following wind did not detract from the merit of this quite sensational performance.

The Air Ministry initially ordered the 1,000 Hurricanes which had been laid down and further contracts were placed with the Canadian Car and Foundry Company, in Montreal, and with the Gloster Aircraft Company. During July, 1935, the Hawker Siddeley Aircraft Co., Ltd., was incorporated and took over the Armstrong Siddeley Development Co., Ltd. (This last-named company controlled A. V. Roe and Co., Ltd., Sir W. G. Armstrong Whitworth Aircraft, Ltd., Armstrong Siddeley Motors, Ltd., and Air Service Training, Ltd., but once the merger had been effected Hawker Aircraft, Ltd., reverted to the status of a private company).

Before we resume the story of the Hurricane, the production of two closely-related two-seaters—the Henley light bomber and Hotspur turret fighter—must be recorded. In both types the outer wings were interchangeable with those of the Hurricane, but the full benefit of this signficant fact was never to be felt, for only 200 Henleys were built (and those—to the disgust of those who knew the qualities of this fine-looking machine—were diverted to target-towing duties), while the Hotspur flew only as a prototype.

Hurricanes in Action

On the outbreak of war the Hurricane was firmly established in R.A.F. service. Nos. 1 and 73 Squadrons were immediately posted to France and to these units fell the honour—and, having regard to their exploits, the glory—of being first in the fray alongside the French Curtisses and Moranes. Their small turning radius—the reward of a moderate wing loading—and devastating fire power quickly gained the Hurricanes the ascendancy over the faster Me 109s, while their performance at high altitude enabled them to deal with the Do 17 reconnaissance machines.

During 1940 Hurricanes were operating from the frozen lakes of Norway and in the fighting withdrawal a number were flown on to the deck of H.M.S. *Glorious*, though, of course, they had no arrester hook like the later Sea Hurricane. Dunkirk, too, saw the Hurricanes—patrolling from English bases and lashing the Junkers and Messerschmitts with their converging streams of bullets.

The R.A.F. order of battle on the opening of the Battle of Britain included 30 squadrons of Hurricanes (well over 2,000 having been turned out from Kingston, the new factory at Langley and other centres), and 19 squadrons of Spitfires. The exploits of the Hurricanes are already history. From their airfields in the south these drab, grimy monoplanes, gun ports and bullet holes hastily patched, were flown into the summer sky by a few hundred tired young men on sortie after sortie, from dawn to dusk, day in, day out. It was then that a typewritten contract reading "One high-speed monoplane" took on something of the dignity of a Bill of Rights or Magna Carta.

From the hundreds of stories of fortitude and heroism told of Hurricane pilots in the Battle of Britain, one runs strikingly parallel with that of Major Barker and his Snipe. It concerns F/L. J. B. Nicholson, who found himself in the presence of the enemy over Southampton, never yet having fired his guns in anger. Without warning four cannon shells from an unobserved Me 110 exploded in the cockpit. With one eye blinded by blood, and his left heel shattered, Nicholson took evasive action as the cockpit began to fill with flames. Suddenly he saw his adversary, who had overshot,

directly in his gun-sight, and with the flesh peeling from his hands, on gun-button and throttle, he fired again and again. The 110 went lurching down into the sea, and, with a final tremendous effort Nicholson managed to bale out. His exploit earned him the first V.C. awarded to a pilot of Fighter Command.

The Battle of Britain past, the Hurricanes became the scourge of the enemy on 30 or more different battlefronts and—catapulted from merchant ships or flown from the decks of carriers—over the oceans also. They were in the forefront of all the Eastern Mediterranean and East African campaigns; they were in Italy and Russia, Ceylon and Burma—everywhere, in fact, where the Service had need of a fighter, light bomber or rocket-firer with a capacity for work and a propensity for adaptation.

It is said that somebody once listed the Hurricane and its variations and found that they totalled well over 100; and he was probably not far wrong. We ourselves must be content with identifying the principal sub-types after the Mk 1 of the Battle of Britain—itself powered with a Merlin II or III engine and, latterly, having a D.H. or Rotol constant-speed airscrew. Armour plating, an air cleaner and desert equipment were additional loads.

The Hurricane II had the Merlin 20 engine with two-speed supercharger, a new engine mounting, and strengthened fuselage and undercarriage, and was produced in various forms; thus, the Mk IIB had 12 0.303in guns; the IIC four 20 mm British Hispanos, and the IID two 40 mm Vickers guns and two 0.303in guns, in addition to extra armour for ground attack. During 1941 the IIB and IIC were fitted with carriers for two 250- or 500-lb bombs or for 45- or 90-gallon drop-tanks. The Hurricane III had a Packard Merlin engine. The wings of the Mk IV (Merlin 21 or 22), were adapted for a variety of armament loads, including eight of the new rocket projectiles, and the Hurricane V (only two of which were built) had the Merlin 27 or 32. Canadian-built Hurricanes were the Mk X (Packard Merlin 28) and Mks XII and XIIA (Packard Merlin 29). The Sea Hurricane I was the first deck-landing conversion from the Hurricane I; the IA had catapult spools and other equipment for use from catapult-equipped merchantmen; the IB had deck arrester gear; and the IC was a deck-landing version with four-cannon wings. The Sea Hurricane II had the Merlin 20, but no catapult points, the XIIA was Canadian-built, with Merlin 29, and the so-called "Hooked Hurricane II" was, as might be supposed, a Hurricane II with arrester hook for training on dummy decks. The Hurricane was chosen for towing experiments with a Wellington tug; a float undercarriage was designed for the Norwegian campaign, but never fitted, and one prototype was partially built to take a Griffon engine. To improve take-off with overload the Hawker/Hillson "slip-wing" Hurricane, having an auxiliary wing which could be discarded at will, was developed, and after the war a two-seater was supplied to Iran.

Last of the Many

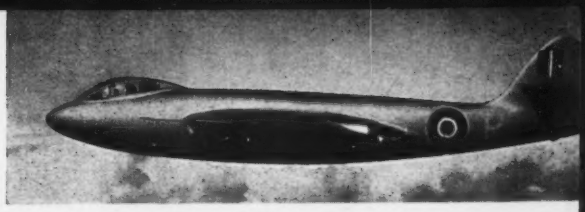
Delivery of the last Hurricane—*the Last of the Many*—was marked by a gathering at Langley in September, 1944, at which the directors, in the persons of Sir Frank Spriggs and Mr. Camm, and the workers, represented by Mr. Oke and Mr. Jones, addressed the assembly, and "George" Bulman (by this time Group Captain and himself a director) put this historic machine through its paces. "George" was accompanied in the air by Philip Lucas in the veteran Hart "MR" and by "Bill" Humble in one of the new Tempests. Messrs. Swift, Stammers and Bound were there to represent the great Rolls-Royce, Rotol and Dowty concerns, which had made such vital contributions to the Hurricane's success. Altogether, it was a day to remember.

Thus having sketched the Hurricane's career, it is now necessary to think back to the year 1937—only a year or so after the very first Hurricane had taken the air. At this date the design staff was already getting to work on drawings for much more advanced fighters, and these, to Specification F.18/37, were to materialize as the Typhoon and Tornado.

Structurally both types were similar: the wings were all-metal; the front part of the fuselage was of steel tubing, and the aft portion consisted of a stressed-skin, flush-riveted monocoque. But whereas the Typhoon had the H-type Napier Sabre engine, the Tornado was built round the X-type Rolls-Royce Vulture. The first Tornado was completed in 1939 and was armed with 12 guns. A programme for production of the type at the Avro factory was abandoned due to difficulties with the Vulture engine, leaving the experimental department more or less free to concentrate on the Typhoon.

The prototype of the Sabre-powered Typhoon was completed in January, 1940, and it was during the following month that Philip Lucas won the George Medal for saving this precious machine by his gallant conduct. When the stressed-skin covering began to tear away from its rivets, Lucas would have been fully justified in baling out, so extreme was his peril; but he chose to stay with the aircraft and landed it safely.

Performance trials with the Typhoon were encouraging and a contract was placed by the Ministry of Aircraft Production with Gloster Aircraft, Ltd., allowing the parent company to implement its vast Hurricane programme. During 1941 a Typhoon was modified experimentally to take the 2,500-h.p. Bristol Centaurus V radial, and with this unit the top speed was about 425 m.p.h.



Hawker's first jet fighter: the P.1040, with Rolls-Royce Nene.

Typhoons were first reported in action in the Dieppe raid of 1942, and when, later in the year, the Me 109 and Fw 190 tip-and-run raiders began their depredations against Southern England, the "Tiffies" were put on to them. As fighter/bombers (2 × 1,000 lb) or "rocketeers" (eight R.P.s) the Typhoons of the 2nd Tactical Air Force proved themselves devastating close-support weapons, and distinguished themselves particularly in the Battle of Normandy, where they decimated a large concentration of armour before Avranches, opening the way for the liberation of France and Belgium.

Variants were the IA, with 12 0.303in Browning guns, and the IB, with four 20 mm British Hispanos.

The last of the Hawker fighters engaged in World War II was the Tempest, which, though it was a logical development of the Typhoon, had a somewhat involved early history. Briefly, it may be explained that of a number of prototypes projected Mks 1, 2 and 5, powered respectively with the Sabre 4, Centaurus 2 and Sabre 2, were ordered. The initial contract was for the Mk 5 and the first off the line was flown by "Bill" Humble in June, 1943.

The Tempest was an object lesson in aerodynamic refinement, for its thin, semi-elliptical wings and careful finish gave it a substantially higher performance than the similarly powered Typhoon. In the Mk 5, Series 1, tubular construction was used for the rear spar attachment, and the rear fuselage and tail end were not detachable; in the Series 2 the fuselage tail end was detachable, short-barrelled guns were installed, a spring tab was added to the rudder, small-diameter wheels were fitted, and the rear-spar attachment was cast in one piece. This version had an all-up weight of 11,800 lb and attained a maximum speed of 435 m.p.h.

The speed of the Tempest was to prove providential within two months of the formation of the first squadron, for it was then that the Germans launched their flying-bomb offensive against Southern England. Of the loathsome "doodlebugs" one Tempest wing alone, commanded by W/C. Roland Beamont, is credited with having destroyed more than 600. Next, over the Low Countries and Germany, Tempests were pitted against the first of the enemy's turbojet fighters—the Me 262—and achieved a number of splendid successes, though the Messerschmitt was nearly 100 m.p.h. faster and mounted the devastating armament of four 30-mm guns.

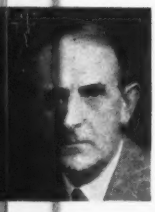
Following the Tempest 5 on the production lines came the Centaurus-powered Mk 2 (primarily intended for service in the Far East and destined to continue in R.A.F. service as a standard fighter/bomber until replaced by jet-propelled Vampires), and the Mk 6, powered by the Sabre 5 and indistinguishable from the Tempest 5 except in having small intake ducts in the wing roots.

Of this last development a colleague, who had considerable experience of the type, has written: "For all its seven tons and somewhat awe-inspiring appearance, the Tempest was one of those all-too-rare aircraft for which, even on first acquaintance, the pilot instantly sensed the beginnings of a lasting friendship. The hearty stab in the back which followed the opening throttle on take-off contained no hint of viciousness; rather was it a reassuring reminder that the aircraft was all on your side. That playful swing, too, was really just a timely hint that your full co-operation would be appreciated on the flight which lay ahead. Once off the ground, in its true element, the machine abandoned this bantering attitude and, like the thoroughbred it was, became at once obedient yet highly sensitive.

"In peaceful passage the Tempest was coy and graceful, but in bellicose mood a tight-reined fury awaited the pilot's command. At all speeds and in all attitudes it handled superbly. There was poetry in the feel of its controls—and this comes, be it said, from one who was weaned on Spitfires. All the production marks of Tempests were fine aeroplanes, but the Mk 6 particularly was a real memory-maker. The effortless 2,700 h.p. from its smooth running 24-cylinder Sabre 5A, the feathery touch of its spring-tab controls and its natural docility, even gentleness, made the Mk 6 an exciting companion for romping among the cloud-tops."

But for all its speed and hitting power the Tempest was by no means Mr. Camm's last word on piston-engined fighter design: that distinction was to fall to a machine which combined in such high degree the qualities of its predecessors that revival of a great family name was deemed to be merited; and so, to Specification F.2/43, came the Fury 1 monoplane, powered initially by the Napier Sabre 7 engine and distinguished from the Tempest by its smaller dimensions (span, 38ft 5in), in having a fuselage of

FIGHTING BREED . . .



monocoque construction throughout and a newly designed tail. Prototypes were flown with the Bristol Centaurus 18 and Rolls-Royce Griffon engines, but the Sabre version, with a top speed of over 460 m.p.h., was the fastest.

Being well supplied with Tempests, and, in any case, committed to a jet programme, the R.A.F. took no Furies into service; to Specification N.7/43, however, a deck-landing version, known as the Sea Fury, was developed and put into quantity production. Three versions—the F.B.10 and F.B.11 fighter/bombers, and the T.21 two-seater trainer—have been supplied to the Royal Navy. The F.B.11 has a maximum speed of 450 m.p.h. at 20,000ft and climbs to 16,000ft in 4.35 minutes. The four 20 mm guns are supplied with 580 rounds, and there are carriers below the wings for two bombs (500 lb or 1,000 lb), 12 5in rocket projectiles, or four of the big "Triplex" R.P.s with 180-lb heads.

Though the Sea Fury came too late for the German war, it was to play—indeed, continues to play—a very distinguished part in the Korean campaign,

Sea Furies are standard equipment in the Royal Canadian Navy and the Royal Netherlands Navy, and land-based Furies have been supplied to Iraq, Egypt and Pakistan.

One cannot help speculating if any pilot living has handled all the main types of Sopwith and Hawker piston-engined fighters up to the Fury monoplane. The incomparable "George" Bulman, as is well known, flew a number of the Sopwiths and tested every Hawker prototype from the Horsley II to the Hurricane, and G/C. E. F. Haylock, Editor of our associated journal *Yachting World*, confesses that not only did he fly the Pup, 1½-Strutter, Triplane, Camel, Dolphin and Snipe, but instructed in very rare dual Camel (and, later, the dual Snipe) and tried his hand at the experimental Buffalo and the civil Gnu also. Latterly he delivered the first Fury biplane to No. 43 Squadron at Tangmere and, after flying various Hawker two-seaters, including the Tomtit, rounded off his score with a Hurricane.

After the war there was considerable comment that Hawkers seemed to be rather slow in developing a fighter for the revolutionary turbojet power, for it was recognized that the new prime mover must inevitably supersede the piston engine in the fighter field. But, as might be supposed, the possibilities of the jet had not escaped the notice of the Kingston technicians; they were, however, equally aware of its inherent shortcomings, notably that of intemperate fuel consumption, and were determined accordingly that their first jet fighter should be possessed not only of high performance but of long range also.

Their initial proposal was declined by the Air Ministry—not, be it said, due to any inferiority, but because the R.A.F. was firmly committed to the Meteor and Vampire. The Naval authorities, however, viewed the drawings of the beauteous Nene-powered fighter with great interest and asked Mr. Camm to make the overload tankage a normal load and incorporate certain other modifications.

The first prototype was not, however, fully "navalized". Designated P.1040, it was first demonstrated by Trevor ("Wimpy") Wade at Langley in August, 1948, and of this occasion we wrote: "Onlookers who are now *blasé* where ultra-fast aircraft are concerned, remarked on the lack of noise—possibly a result of the bifurcated jet trunk, the main advantage of which appears to be the allowance of an unusually large internal tankage. These hardened observers, in unison with Hawker's Langley staff, justly applauded Mr. Wade after his memorable demonstration of a very beautiful and obviously 'right' aircraft. . . . Wade's judgment was perfect throughout, and fully worthy of that displayed by Mr. Sydney Camm and his design staff who have so brilliantly balanced speed and rate of climb against range and other qualities demanded of a modern Naval fighter."

At the S.B.A.C. Display in 1951, the P.1040 appeared as a flying test-bed for the Armstrong Siddeley Snarler liquid rocket, which was neatly built into the tail. With this auxiliary unit the P.1072, as this development is known, is still undergoing trials.

Fully conscious of the benefits promised by swept wings, the company next proposed—and were authorized to proceed with—a developed type, designated P.1052 and having wings swept back at 35 degrees. These consisted of two main spars with a leading edge shear attachment, interspar and nose ribs and heavy-gauge skin covering. The broader root chord enabled deeper spars to be employed, and these considerably alleviated the increased bending and torsional loads arising from the sweep-back. The split-jet system was retained for the Nene and the 1052 proved in all respects a most rewarding experiment.

One of the two P.1052 airframes has since been modified to meet Naval requirements.

In succession to the P.1052 came the all-swept P.1081 with tail jet orifice, and this type distinguished itself only three days after its first flight (on June 20th, 1950) by flying to Belgium and putting up a high-speed aerobatic performance which left a vast Continental audience aghast. Only one example—VX279—was constructed, and it was on this machine that Trevor Wade met his death on April 3rd, 1951.

For a period it was confidently expected in some quarters that the P.1081 would be adopted for R.A.F. re-equipment; but such a substantial improvement in performance was promised by a developed version, taking advantage of the Rolls-Royce Avon and of the latest aerodynamic techniques, that it was decided instead to order this type—the P.1067—"off the drawing board".

This latest product is a considerably larger machine than its Nene-powered progenitors; the fuselage is of more cylindrical form and the undercarriage of wider track. A characteristic spine runs atop the fuselage, and the wings and tail surfaces are a new harmonious combination of curves, straights and points. Like other forms of beauty, the lines of an aircraft are largely a matter of individual taste, but there is general agreement that, aesthetically, the P.1067 is the most appealing of all the Hawker creations.

Among the technicians who share the credit for the 1067 with Mr. Camm are: R. H. Chaplin, O.B.E., B.Sc., F.R.Ae.S.; J. V. Stanbury, A.R.Ae.S.; F. Cross, A.F.R.Ae.S.; H. Tuffen; J. Barrett, A.M.I.Mech.E., A.F.R.Ae.S.; H. E. J. Rochefort, Whit.Sch., A.C.G.I., D.I.C., A.M.I.Mech.E., A.F.R.Ae.S.; C. P. Plantin, B.Sc., A.F.R.Ae.S.; W. Weetman, A.F.R.Ae.S.; S. Fairev, B.Sc., A.M.I.Struct.E.; T. Wake; P. W. Wreford-Bush, A.F.R.Ae.S.; R. B. Marsh, A.F.R.Ae.S.; J. D. Stranks, A.F.R.Ae.S.

When Neville Duke gave his first demonstration of this newest Hawker at Farnborough this year (as recounted at the commencement of our story) he left the assembly of thousands visibly unstrung by the flashing speed of his low-level runs; but on no one did he leave a deeper impression than on the American commentators, certain of whom had seen the world's record-breaking F-86 achieving its 670 m.p.h.

Though it was common knowledge at the time that the P.1067 had completed only a few hours in the air, the public were not aware that it was flying precisely in the form in which it left the experimental shop, and that Duke had put it through a similar aerobatic performance on his third test-flight.

The exact speed attained at Farnborough has not yet been disclosed, nor is it likely to be for some time to come; but as it is a proud Hawker claim that the Fury biplane was the first fighter to achieve over 200 m.p.h., the Hurricane the first over 300 m.p.h., and the Typhoon the first over 400 m.p.h., so it may well be that in due time a "first over 700" may be added to the honours of this fighting breed.

HAWKER EXECUTIVES

Left, reading down: Sir Frank Spencer Spriggs, K.B.E., Hon. F.R.Ae.S. (chairman); T. O. M. Sopwith, C.B.E., Hon. F.R.Ae.S. (director); S. Camm, C.B.E., F.R.Ae.S. (director and chief designer); A. N. Spriggs, O.B.E. (director and general manager); E. H. Jefferson (works director); J. T. Lidbury (secretary). Below, left to right: R. H. Chaplin, O.B.E., B.Sc., F.R.Ae.S. (asst. chief designer); J. D. Stranks, A.F.R.Ae.S. (chief experimental engineer); E. G. Rubython (asst. secretary); F. C. Lock (production manager); G. Anderson (foreign sales and publicity); S./L. Neville Duke, D.S.O., D.F.C., A.F.C. (chief test pilot).

SEA HAWK ... unmistakably Hawker !

Hawker's superb P.1067 fighter for the R.A.F. has a true blood brother in the Sea Hawk, now going into service with the Royal Navy. For the tricky job of deck-landing, unusually wide flap area and big air brakes give the Sea Hawk matchless flying qualities. Power folded wings lick the storage problem. Long endurance, superb climb and killing armament are other qualities that made the Sea Hawk the Navy's choice. With the cleanness of line and the eager, "thoroughbred" look that distinguish all Hawker fighters, the Sea Hawk wins a worthy place with Hurricane, Hart, Typhoon, Tempest, Sea Fury . . . other illustrious names of Hawker's world-beating fighter brood.

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Do you remember ?

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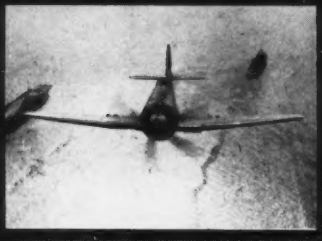

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6

The Hawker planes that you see on this page have all written aviation history. How many of them do you remember? It is a Hawker tradition not only to have written the history of the past, but to shape the course of the future, by giving aviation the planes of to-morrow, to-day

1. Sopwith Camel. *2. Sopwith Pup.*
3. Hawker Hart. *4. Sopwith Snipe.*
5. Hawker Typhoon *6. Hawker Tempest.*
7. Hawker Sea Fury *8. Hawker Hurricane.*

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THE THROTTLE-BENDERS

No. 3 . . . . . A. L. COLE

By H. J. COOPER

Comper Swift G-ABUS, "Black Magic," in its present form, with proud owner. The photograph was taken at this year's Goodyear Trophy Race.

THIS is the third of a series of articles describing the air-racing careers of the present six members of the "Throttle-Benders' Union"—the unofficial brotherhood of regular participants in British air races. The other five pilots are S.L. J. Rush (the subject of the first biography in this series, published in "Flight" of July 6th last), J. N. Somers (October 5th), R. R. Paine, C. G. Alington and F. Dunkerley.

THE youngest member of the Throttle-Benders' Union, Tony Cole is a good example of what the Americans call "a pilot flying on a shoe-string." Not many young people today can afford to own and maintain a private aircraft: the situation is in striking and not very cheerful contrast to that of 20 years ago, when Moths and Avians and the like were owned by many young men and women whose financial status did not cause them any embarrassment. Today, with few exceptions, it is only the successful businessman who has attained middle-age and a reasonably secure position (the second qualification is apparently unattainable without the first) who can afford to own an aircraft privately—or use his company's aircraft for business and private purposes. How Tony Cole has managed it is something approaching a miracle, and something which he himself has not yet quite understood !

Tony was born in Nyasaland in 1928, and on a brief visit to this country four years later was taken for a flight at Croydon in an old Fokker monoplane. (He has little recollection of his air baptism, but the Fokker was most likely G-EBUT, the famous F.VII which Air Taxies used for joy-riding about that time.) From then onwards his interests lay almost entirely in the air. Back in Africa he was able to gratify his keenness a second time. When, in 1936, the Rhodesia and Nyasaland Airways service from Salisbury, Southern Rhodesia, to Nyasaland was begun, European residents were invited to fly in the first aircraft to arrive. Tony flew with a party of friends; and then went home, changed his clothes and presented himself at the airport again ! Although he was promptly recognized, his enthusiasm and persistence were rewarded by another flight.

In this country once more, he became a member of the Air Training Corps and began flying on primary gliders. At his local station—Burgess Hill, Sussex—he made 22 ground-slides before, as he says, his instructor risked sending him solo; and his total time in the air, including seven more glides, could be counted in minutes on one hand.

He was too young to serve in the forces during the War, but immediately afterwards joined the de Havilland Aeronautical Technical School at Hatfield, where he entered the aircraft design section. At this time—1946—the flying clubs, not fully aware of the difficulties ahead, but with plenty of enthusiasm, were trying to resume flying activities where they had left off in 1939. Tony, together with a fellow South African, Arthur Meechin, became one of the first members of the Luton Flying Club, the second club to revive after the War. His instructor there was "Shep" Shepherd, who sent him solo after 4 hr 10 min dual in a Tiger Moth. Tony gained his "A" Licence after 8 hr 50 min, and began adding up his flying hours on Club aircraft. Happy days !

But club flying, while temporarily satisfying, is to many pilots merely a step towards ultimately becoming an owner. Meechin bought one of the few remaining Comper Swifts, G-ABPR, which he had discovered in a nearby garage, but returned to Africa before getting it airborne. Cole had agreed to buy it from him, but unfortunately it was completely destroyed by fire at Broxbourne, before the transfer could take place. Strongly attracted by the general appearance and the brilliant historical record of the Swift, Tony was now even more keen to acquire another if one could be found. At that period many privately-owned aircraft which had not flown since 1939 were to be seen in various hangars and garages around the country, and after much investigation Tony discovered the crashed remains of another Swift, G-ABPE, which he purchased for £20. But the damage to it was greater than he thought; there was no hope of making it airworthy and subsequently it was used only for spares. So Tony had to suspend—temporarily—his desire for an aircraft of his own.

While at de Havillands in 1947, Tony took part in his first air race. In the Folkestone Air Trophy contest at Lympne that year he flew one of the Luton Flying Club's Tigers, G-AHDF—completely standard and straight from circuits and bumps—and managed to average 102.5 m.p.h. over the three 21-mile laps of the course. He finished third in his heat, and was seventh in the final, flying at 108 m.p.h., which is a very good speed for a Tiger Moth. The experience

Tony Cole's first race was the 1947 Folkestone Trophy, in which he flew the Luton Club's Tiger Moth seen here.

THE THROTTLE-BENDERS . . .

afforded him by this race was well worth his entering, not to mention the fun of it.

Meanwhile his search for a Comper Swift continued. He had not lost interest in this smart little monoplane, and his next contact with one came through overhearing a conversation in the bar at the Luton Flying Club. A party of pilots from Sywell was temporarily grounded by weather, and one of them mentioned that he owned a Swift! It was stored away in a converted barn, whence it had been for the past nine years, and the owner very generously said that Tony could have it if he cared to take it away. It turned out to be G-ABUS. A few days later (on February 18th, 1948) a lorry was hired and Tony and a friend, Desmond Norman (son of the late Sir Nigel Norman, one of the founders of Heston Airport and of Airwork, Ltd.) went out to collect the Swift. They found it in much better condition than they expected, and they agreed to pay the owner £50 for it should they get it into the air before the coming Christmas. A ground-engineer friend agreed to inspect it, and then offered to do the whole job for another £50, so Tony and Desmond told him to go ahead. They were to become joint owners.

Unhappily, as on so many occasions, the initial estimate proved considerably lower than the final sum. Even with the great amount of work done by Tony and some friends the estimate subsequently amounted to £190, which was much more than either of the new owners could afford. But as the Swift was by this time all in pieces, and they could not take it away, there was nothing to do but agree. At this point Tony assumed complete ownership, and came to an agreement with the engineer that, when G-ABUS was airworthy, he should sell it so as to cover the costs incurred. Not, perhaps, a very profitable arrangement, but that was the only course to take. There was no other Swift flying anywhere, which did not make the reconstruction job any easier; but the Heston Aircraft Company (which had taken over the Comper concern in 1934) supplied the original drawings and, months later, G-ABUS, with its 75/85 h.p. Pobjoy R radial engine, was completed. It was flown for the first time in its rebuilt form on June 25th, 1948. Flight tests proved satisfactory, and a Certificate of Airworthiness was granted.

The Swift is one of the few aircraft produced in this country specially for racing. It was designed by F/L. Nicholas Comper (who died in 1939) and first appeared in 1929, powered by a 40 h.p. A.B.C. Scorpion engine. Later models had the 75/85 h.p. Pobjoy R, one the 90 h.p. Pobjoy Niagara and two—one of which, flown by F/L. (now A Cdre.) E. H. Fielden, made second place in the 1932 King's Cup—had the D.H. Gipsy III. The Swift is a very small monoplane, with a span of 24 ft, and while the view from the cockpit is rather limited by a central cabane, it makes a splendid little racer. Since 1930, there has been at least one Swift in each King's Cup race, and the type has made many long-distance flights all over the world.

G-ABUS as it was when first made airworthy by Tony Cole. It was then without a head-fairing behind the cockpit, and lacked a number of detail speed-conferring refinements.

Naturally, Tony was far from happy at the prospect of having to sell the rebuilt Swift to pay for its overhaul, but circumstances changed suddenly when Jack Linnell (one of the founders of the flying club at Sywell in 1927), who had transferred the Swift to Tony, offered to pay the bill, which by that time had risen to over £250; the offer was made under a gentleman's agreement that, should the Swift be sold, the money would be repaid. This was a truly generous and sporting gesture of which Tony was fully appreciative.

With the Swift in his possession the new owner began taking it round the country, starting on July 17th, 1948, when (only 21 hours after having first flown it) he took it to Hendon to attend the rally organized by the Women's Junior Air Corps. The Ultra Light Aircraft Association had arranged a "round-the-perimeter" race for light types (shades of 1913!) as a climax to the display. Tony was asked to enter the Swift which, weighing only 985 lb, comes within the "ultra light" category. After an amusing race Tony found himself the winner—but not, he thinks, purely by merit! The prizes were presented by Miss Valerie Hobson of film fame, and one of the accompanying pictures shows Tony with her.

After this Tony Cole began to get down seriously to racing the Swift, as often as finances would allow, when he was not studying at the Technical School. Although still finding it difficult to maintain the aircraft he managed to keep it airworthy and insured for the summer months, and placed it in storage for the rest of the year.

His next air-racing success was in the Siddeley Trophy contest at Wolverhampton on October 17th, 1948, when, flying the Swift (as representative of the Luton Flying Club) he finished second at 122.5 m.p.h., just failing to catch W. M. Morris's Autocrat (Midland Aero Club), but ahead of Dr. L. W. Hamp flying the Wolverhampton Club's Auster 5. Tony had won his heat at 121.5 m.p.h. Having been round the course he had a better idea of the landmarks, and was able to fly it with a little more accuracy in the final so as to save valuable seconds at the turning points.

With the inauguration of the National Air Races at Birmingham in 1949, Cole was able to compete in a major speed contest for the first time. The Swift was specially tuned and cleaned up. It was resprayed with a high-gloss black finish, and all the control surfaces were taped over; the wing-folding slots were covered up and a rear head-fairing was added. He was entered for the King's Cup, and quite a lot of publicity attached to the Swift and its pilot; the lay Press entertained its readers by telling of the

Miss Valerie Hobson (apparently registering sadness) inspects the cockpit of G-ABUS, with owner in attendance.

20-year-old pilot and his 18-year-old aircraft which had been discovered almost derelict in a barn. Tony found himself in Heat 1 for the King's Cup. He took off first (thus, incidentally, being the first pilot to fly in the National Air Races) and, flying at an average speed of 126 m.p.h., arrived third, which got him into the final. There, on the last lap of the 20-mile course, it looked as if he would be second to Nat Somers' winning Gemini, but a mere 200 yards from the winning post he was passed by Ron Paine. So he had to be content with third place, but the prize of £50, plus the £10 heat prize, was a welcome contribution towards the Swift's upkeep during the rest of the summer months.

Next year he was again entered for the King's Cup, held at Wolverhampton. There were 36 entries, including another Pobjoy-Swift, G-ACTF, which had just been restored to the Register by R.E. Clear. Tony had to give 50 seconds start to this Swift, but soon overtook it, while maintaining an average of 126 m.p.h. over the course. This speed was identical with that recorded the year before, as the aircraft had not been further cleaned up. He finished 12th, as his handicap had been increased, but during the course (which measured 100 km) he established a speed

The purposeful, highly distinctive lines of the little Comper Swift are apparent in this 1949 King's Cup picture.

record over this distance in Class C.Ia (that is, for aeroplanes of less than 500 kg weight) which still stands as a world class record for this country at 126.22 m.p.h. On the next day Cole finished fourth in the Goodyear Trophy Race, also flown at Wolverhampton.

In 1950 he also entered for the Grosvenor Challenge Cup race at Woolsington, Newcastle-upon-Tyne, but was unable to compete as he had broken his airscrew while taking off for a practice flight for the Yorkshire Aeroplane Club's race a fortnight before.

He was also in the first *Daily Express* race, from Hurn to Herne Bay on September 15th, 1950, and out of the 67 starters finished 12th after taking off 25th. He was second in his weight class, but first place went to Ron Clear's Swift, on which much work had been done to improve its speed. Tony's speed was 137.86 m.p.h., but it must be remembered that all competitors in this race had the advantage of a tail-wind for most of the way, which added 9 or 10 m.p.h. to the Swift's speed. For this race Tony completely overhauled G-ABUS, adding lots of small fairings, and, by very carefully polishing and balancing, the airscrew increased "maximum" revs. by 100! Clear's Swift proved 3 m.p.h. faster, perhaps because he had spats fitted and no engine-cooling baffles.

Which event brings us to 1951. Cole's first race this year was the Goodyear Trophy event at Wolverhampton, wherein all of the competing T.B.U. pilots made a good showing. Tony had overhauled G-ABUS and its Pobjoy after its winter storage and, by removing the cooling baffles (as Clear had done) to reduce drag caused by air passing through the engine bay, he succeeded in getting 131 m.p.h. (Incidentally, this modification also resulted in better cooling!) In the race he made second place, ten seconds behind Fred Dunkerley in the Miles M-28, and was chased to the winning post by Ron Paine in his Hawk Speed Six. Jimmie Rush made fastest time in his Falcon Six.

Tony's next race was the *Daily Express* South Coast contest, flown from Shoreham on September 22nd. By then, thanks to the generosity of an enthusiastic Wolverhampton Aero Club member, the Swift had been fitted with a 90 h.p. Pobjoy Niagara engine, and although for some time before the race it looked as if Tony might be a non-starter because of magneto trouble, he managed to get the engine running satisfactorily in time. Twenty-nine competitors took off before Philip Mayne dropped his green flag to let G-ABUS away, for the handicappers evidently expected the more powerful Niagara to make a lot of difference to the Swift's speed. But he came in over the finish at Brighton's West Pier in 26th place, 12 minutes after Hugh Kendall's winning Chilton, having averaged 138.5 m.p.h.—a very satisfactory increase.

With that event Cole's racing has ended for the time being. After leaving de Havilland's he entered the design office of the English Electric Company, but earlier this year had the choice of two jobs. One was a commission in the R.A.F.—the other with an oil company in Abadan! After joining the R.A.F. he took a commission in the Engineering Branch. Following the O.C.T.U. at Spitalgate and three months with No. 264 Squadron (night fighters) Tony is, at the time of writing, taking a course at the R.A.F. Technical College at Henlow. His total flying time amounts to 250 hours—a low figure compared with that of some of the Throttle-Benders, but one which makes his successes the more surprising. He has still to score a "first" in a major race, but one does not doubt that before very long the Comper Swift will be able to pull it off. On the technical side, he is a graduate member of the Institute of Production Engineers and of the Royal Aeronautical Society.

TRANSONIC TRIBULATIONS

ON Thursday of last week a "main" lecture of the Royal Aeronautical Society was given at the Cheltenham branch, the lecturer being Mr. A. N. Clifton, B.Sc., F.R.Ae.S., who spoke on *Problems of Transonic Flight*.

Saying that the subject theoretically consisted entirely of problems, though in practice the situation was not quite so disorderly as that remark would imply, Mr. Clifton reviewed some of the day-to-day obstacles now facing designers of transonic aircraft. With present knowledge, he said, these problems could be solved only by adding more weight and complication and by increasing the size and cost. In this respect designers of naval aircraft might find themselves unable to relate the increases to the limitations imposed by deck operation; if this proved to be the case, the disparity between the performance of land-based and ship-based aircraft would become more marked than it now is, and still larger lifts, and wider decks and hangars, would then become necessary.

The lecturer gave estimates of the probable degree of size and cost increases which might shortly be expected. "It seems clear," he said, "that on the way to the supersonic plateau not only a sonic cliff but also an economic cliff must be scaled." This latter obstacle was represented by the size, complication and cost of the product, or alternatively by the man-hours needed for its production; it was also reflected in the size of design staffs and prototype manufacturing organizations.

As a result of research, however, the steepness of the drag rise was being alleviated, and for the same reason the increase in cost would also be slowed down.

At present, research was hampered by the fact that there were few aircraft available suitable for taking measurements in flight; it was most important that as new types came into production some examples should immediately be set aside for research and development purposes. Though this would not reduce cost by a given date, it would have the valuable effect of enabling designers to produce better aircraft. We intend to give a digest of Mr. Clifton's lecture in a forthcoming issue.

PASSENGERS, PILOTS AND PSYCHOLOGY

When the Captain Comes Aft: The Right Approach, and its Importance to Air Travel in General

LONG past are the days when an airline pilot was usually observed by his passengers as a carefree individual who trod out his cigarette on the tarmac before jumping aboard at the last moment and disappearing forward, to be seen no more until the end of the journey. Today he has responsibilities comparable with those of the captain of an ocean liner, and in some ways heavier. Not least among them is the maintenance of a "happy ship" for both passengers and crew, and to succeed in this he must be something of a psychologist. His approach to the problem, and its ultimate effect on his employers' reputation, is examined in this article. The author, who wishes to remain anonymous, speaks from many years of practical experience in command of passenger-carrying aircraft.

THIS article is concerned with one specific aspect of an airline captain's job—the comfort, mental and physical, of his passengers. In order, however, that we may see the matter in its true perspective we must recognize that the commander of a British commercial aircraft also has a good many trifling responsibilities, among them being:—

(1) The complete provisioning, cleanliness, loading and refuelling of his aircraft, and observance of health, passport and immigration requirements.

(2) The operation of his company's schedule with safety.

(3) Efficient operation of his aircraft with due regard to economy.

(4) Maintenance of communications, dissemination of position-reports, weather reports and safety messages; telegrams and a continuous listening-watch on international frequencies.

(5) The discipline of his crew and co-ordination of duties of ground officers with those of the aircraft officers in the interests of safety, profit and regularity.

(6) To fly the aircraft in accordance with a mass of legal documents, all of which stress the need for safety; furthermore, to fly the aircraft to the highest flight ratings in the world—those imposed by the British civil aviation authorities.

(7) At all times to promote the policy of his company as a senior (travelling) official.

It must be appreciated, also, that there is a considerable difference between a licensed pilot and a captain; the latter is a licensed pilot, but he is also responsible for much more than the pure flying of the aircraft.

Up to the present, the captains of British aircraft have rarely, if ever, been invited to discussions on interior layout and passenger psychology. These matters are handled by specialists, and all that the captain can do is accept the conditions imposed upon his complement and use his personality and individual talent to overcome points in design which are constantly under criticism. Of course, he renders reports upon his equipment and its faults, but he cannot dictate modifications; he may merely recommend them. I mention this point because passengers spend more time in close proximity to the aircraft officers than to any other officials of the airline by which they travel. They cannot be blamed if they are tempted to pass all of their criticism through the most senior official present—the captain; and the captains, let it be said, prefer this approach.

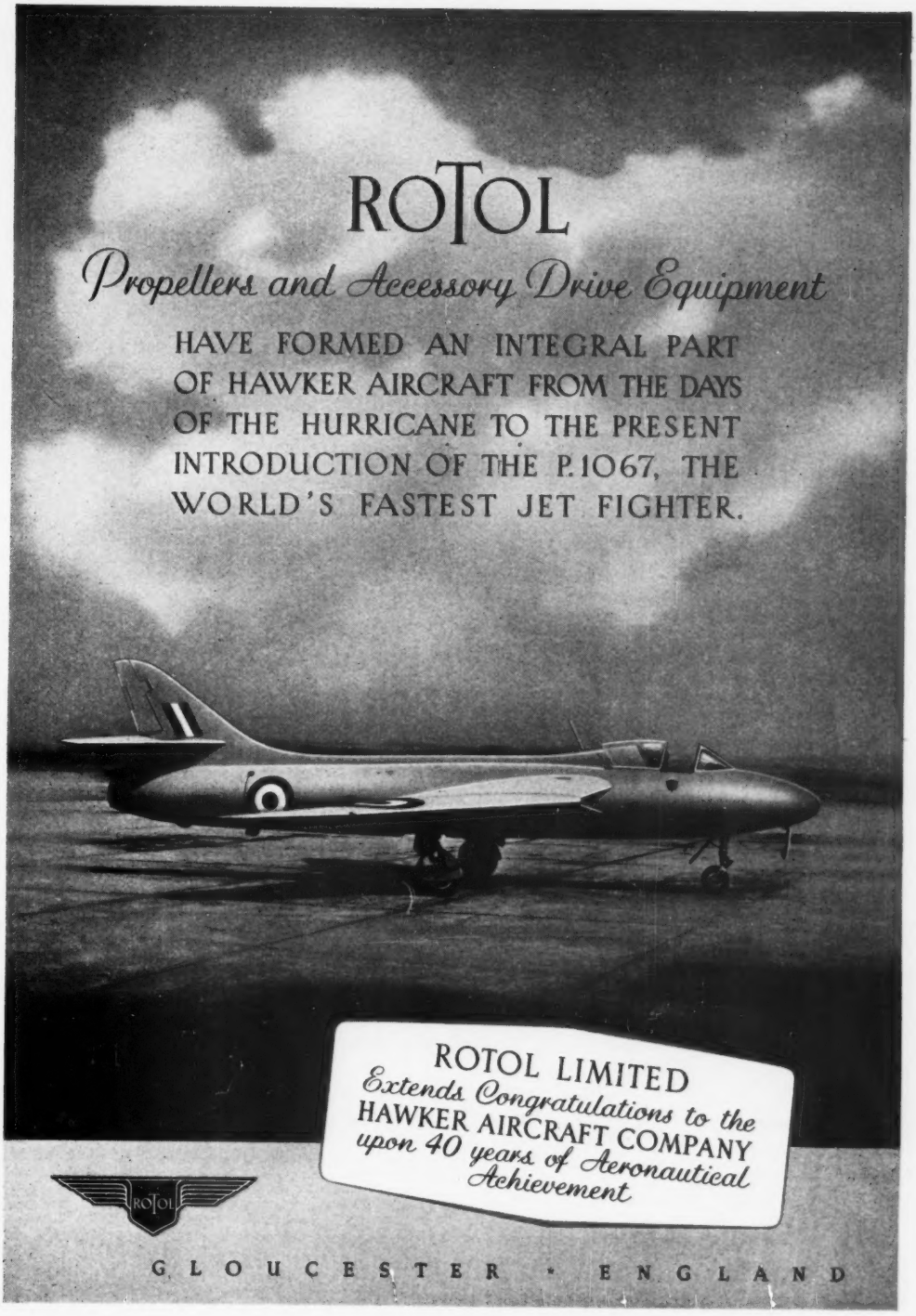
To study the human factor is, perhaps, to trespass upon the preserves of the aviation doctors and psychologists. But one does not need to be a doctor to understand a good many of the usual symptoms and their practical alleviation. The aircraft commander is responsible for many people in the course of a single flight, and he must attempt to prevent rather than cure discomfort in the passenger-cabin. Provided he has an aircraft which is operationally suitable, it lies within his power to avoid those conditions which contribute to discomfort.

Starting with basic principles, let us be fair and say that the state of flight was not meant to be a natural function of the species *Homo Sapiens*. It is not a natural thing, but a synthetic state. Furthermore, the airborne human being is not in contact with the positive means of obtaining lift or defying gravity. He is left seated in a pressure-shell, and cannot even feel his motion through the air. This condition affects his mental acumen and his stomach and, hence, his temper, his appetite and several other physical and mental attributes. It is no exaggeration to say that an almost schizophrenic tendency may develop in a human being transported from his normally two-dimensional existence to the three-dimensional world of flight. This effect must be borne in mind when we discuss impressions in flight; and these self-same impressions can be radically different when viewed in retrospect in a comfortable office or drawing-room. The seasoned captains employed on aircraft today are aware of this factor in passenger-relations and allow for it.

Some people are allergic to all forms of travel and require special handling; others are affected by boredom. The captain naturally tries to avoid turbulent air in order to satisfy the need for a smooth trip, and hence to reduce physical and mental fatigue. Also, the achievement of smooth flight satisfies the need for a steady platform on which to serve the meals so lavishly advertised. This consideration may, on occasions, be incorporated in the captain's decisions upon the operating altitude and the route, and even upon the acceptance of temporary delays. Naturally, the crew themselves wish to avoid turbulent conditions wherever possible and every endeavour is made to avoid such a state of affairs at the meteorological forecasting stage and subsequent flight-planning. However, the "positive-controlled" airways systems of today do occasionally impose unavoidable turbulence when the need for air-traffic separation is predominant.

A smooth ride inspires confidence and alleviates the nervous tension of those who are travelling for the first time, or whose only acquaintance with aircraft has been during an aerobatic joy-ride with an exuberant friend; the latter experience is not conducive to confidence in air travel, and is often responsible for erroneous impressions that are most difficult to correct.

The passenger, then, awaits the hours of forthcoming cruising conditions, and once the aircraft is settled down the commander may be expected to make his first visit aft. Prior to this visit it is customary for the stewards to inform the passengers of the flight time, altitude, cabin altitude,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PASSENGERS, PILOTS & PSYCHOLOGY

stop-over time, types of meals to be served and particulars that will be required at the destination airport regarding passports, immigration and health. All this information is given under the authority of the captain, who, before take-off, has signed a mass of legal documents testifying to, *inter alia*, the load of passengers, their names, weights, sex and nationalities, and details of excess baggage carried.

As the commander steps aft into the passenger-compartment he is likely to find himself confronted with a sea of faces, all belonging to individuals with different views on air travel, and often of different colours and creeds. On making closer acquaintance with this mass sample, he will be able to divide it into three broad categories :—

(*a*) Those who have travelled by air before.

(*b*) Those who have not.

(*c*) Those who must travel by air, but would not do so if the choice was their own.

(*a*) *Those who have flown before.*—Usually these passengers are aware of the intricacies of air travel and understand and appreciate the principal technical factors involved in their defiance of the laws of gravity. Just as the captain will compare him or her with the thousands of other constant travellers, so he or she will, through experience, be qualified in some measure to judge the individual qualities of the various captains met in travel. Like true diplomats, these passengers realize that the commander has a limit to the length of his time aft, and restrict their questions to the sphere of their immediate needs. The opinions of this group of people rarely appear in print. As seasoned travellers, their psychological acceptance of the overcoming of scientific difficulties, plus their knowledge of world-wide standards of aims in passenger-comfort, is usually sympathetic without being too informal. They are the philosophical types who await progress without forcing it against economic facts. Nevertheless, these people do much to increase efficiency by their comments, which are invaluable.

(*b*) *Those who have not flown before.*—These people form the mass of opinion most valuable to the airlines when assessing economics rather than comfort. Their first impressions may well decide whether they will continue to fly at all in the future. They do not wish to be reminded, in the Press, of the crashworthiness of rearward-facing seats or other devices. The mere mention of disaster elsewhere does much to undermine their confidence, and it is for this reason that the commander will refrain from allowing a conversation to drift into the crash-category.

Such passengers often need to be reassured that, whilst the captain is talking to them, the co-pilot is on watch. The explanation of time-difference is essential, and a description of the route makes their voyage less boring. The whole solution to their initial apprehensive state is to supply enough mental diversion to avert boredom and strain. These people would withstand quite calmly any journey by surface transport, however reckless their driver. Yet, in the air, a slight alteration of course on a night flight, a change of airscrew pitch or a slight movement of considerably less force than that involved at a bus-stop will cause them considerable nervous strain. The captain's answer to such qualms are smooth flight, avoidance of turbulent conditions, and use of constant-power cruise with its only very slight r.p.m. variations caused by temperature changes.

A passenger so handled usually stays "loyal" to his first captain and hence to that captain's employer. He never forgets his first flight under tactful guidance, and it is his impressions of an efficient aircraft and commander and crew that will convert him to constant air travel with a particular pilot or company; multiplied by x satisfied passengers, this guarantees bookings.

(*c*) *Those who must travel by air, but would not do so from choice.*—Many company representatives are sent by air in order to speed up sales promotion and business. Some of them inevitably suffer a conflict between personal desires, a spirit of self-preservation and allegiance to their employers (especially if the boss usually travels by the *Queen Mary*). In extreme cases, such conditions can lead to resentment and a general dislike of all things flying, human and mechanical. The good business executive would do well to consider these factors, as very often his reluctant salesman sits next to a competitor who is cheerful and obviously willing to fly.

The main criticisms concerning delays, actions of staff and comfort of aircraft come from the unwilling passenger, for he steps aboard with a predisposition to find fault. He can be readily identified by the commander, and usually can be cheered up by perseverance; however, there are others to consider and commanders cannot afford to waste too much time on these "difficult" cases. Yet even this type of passenger warrants a sympathetic approach, which may ultimately end in "conversion."

These, then, are the three main categories of traveller. There are, of course, sub-divisions; I have not, for instance, mentioned nationality, colour or creed. Thus the cabin temperature over India at 16,500ft might suit Mr. Jones of London, but not Mr. Wun Wing Lo (of Hong Kong) in the next seat. After an adjustment, perhaps, Mr. Elmer P. Knickerbocker, of Houston, Texas, will ask for some humidity with his heating. Creed, too, can demand special meals, and Kosher food must be prepared as readily as Moslem *kabhab*.

It will thus be seen that the captain of an aircraft is indeed the one and only official, readily available to the customers, who embodies all that his company sells in comfort, safety, economics and regularity. In no other occupation, perhaps, is such a mass of departmental work placed in the hands of one man.

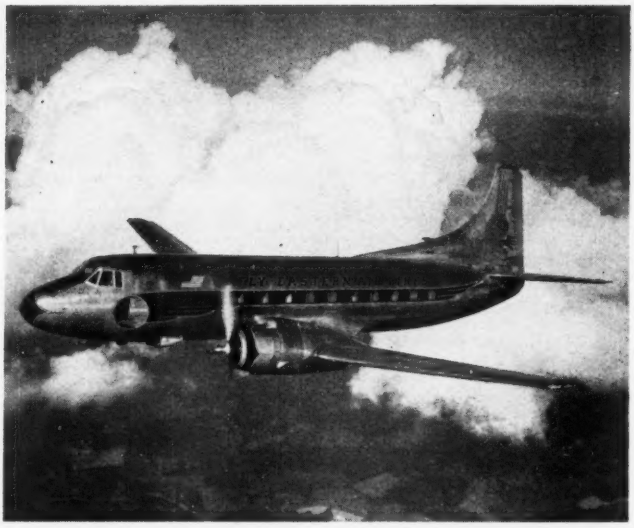
I have already indicated that the captain must also be something of a human encyclopædia. As an example of the range of subjects in which he might be expected to converse more or less intelligently with passengers, the following perfectly genuine list can be quoted: Persepolis, Darius, the Tribes of Abraham, Ptolemy, the Grand Cañon, Sterling Exchange, Tom Prendergast's Political Machine, Tammany Hall, Tokyo Rose, Starvation in Bihar Province, Disraeli, the Burma Road, Turbojets *v.* Turboprops, Nevil Shute, Rock Island Oysters *v.* Watson's Bay Oysters, the Waldorf-Astoria in New York *v.* the Raffles in Singapore, Sir Lee Stack, and the Monroe Doctrine.

Obviously, there is no end to the conversations enjoyed by both captain and passengers in the former's efforts to attract attention to events within the aircraft and away from those outside. Thus conversation, comfort, feeding, drinking and sleeping are a component of the planned flight, the actual flight and the duties of the commander. How well he succeeds in carrying out these duties is dependent to a large degree on his confidence in his aircraft and crew. It is this confidence which he endeavours to instil into his passengers. Even when British operators had only converted military aircraft, passengers preferred to travel under this "personal touch" system—confidence meant as much as pretty posters and free drinks in other more fortunate countries. In a few years' time this factor, coupled with a lead in jet-travel, may well scoop tremendous bookings, from a free market, into the lap of the British airline industry.

FORTHCOMING EVENTS

Nov.	30.	Yorkshire Aeroplane Club Annual Ball.
Dec.	1.	Pathfinder Club Annual Ball, Dorchester Hotel, London.
Dec.	1.	Royal Air Force College, Cranwell: Boxing v. R.M.A. Sandhurst (home).
Dec.	5.	Royal Air Force College, Cranwell: Rugby and Squash v. R.M.A. Sandhurst (home).
Dec.	5.	Royal United Service Institution: "The War in Korea, with Special Reference to the Difficulties of Using our Air Power," by W/C P. G. Wykeham-Barnes, D.S.O., O.B.E., D.F.C., A.F.C.
Dec.	6.	R.Ae.S.: "Air Intakes for Gas Turbines," by J. Seddon, A.F.R.Ae.S.
Dec.	7.	Herts and Essex Aero Club: Annual Dinner and Dance.
Dec.	7.	G.A.P.A.N.: Reception, Mansion House, London.
Dec.	11.	R.Ae.S. Graduates and Students Lecture: "Naval Aircraft," by D. L. Hollis Williams, F.R.Ae.S.
Dec.	18.	R.Ae.C.: Film Show, Londonderry House.
Dec.	20.	R.Ae.S.: "Control-surface Flutter," by E. G. Broadbent, A.F.R.Ae.S., and W. T. Kirkby, A.F.R.Ae.S.
Dec.	21.	Institute of Navigation: "Meteorology and Navigation," by Lt. Cdr. P. G. Satow, D.S.C., R.N.
Jan.	11.	A. and A.E.E., Boscombe Down: Contractors' Dinner.
Jan.	16.	Helicopter Association: "A Review of Helicopter Patents," by L. H. Hayward.
Jan.	18.	Institute of Navigation: "Navigational Errors," by W/C. E. W. Anderson, O.B.E., D.F.C., A.F.C.
Jan.	19.	Aircraft Recognition Society: Hurricane Trophy Competition.

CIVIL AVIATION



EASTERN AIR LINES are now receiving the first deliveries of an order for 60 Martin 4-0-4 airliners. This type incorporates many time-proven features of the 2-0-2, such as integral loading ramps, underwing refuelling and servicing hatches on the underside of the fuselage for hydraulic, electric and other systems.

THE I.A.B.A.

AS the result of a conference held at the International Chamber of Commerce Building in Paris from November 14-16th, the International Aircraft Brokers Association officially came into being. This association has as its objects the closer co-operation of aircraft brokers working on an international basis; the maintenance of a high standard of professional ethics; a general expansion of the air charter business; and the provision of a means of co-operation between the air-freight markets which already exist.

There are three categories of membership, honorary, associate and active. Honorary membership will be accorded to those official bodies or individuals whom the Council of I.A.B.A. considers it in its interests to appoint. Associate membership will be granted to national associations of aircraft brokers, and active members will be chosen from among brokers actually engaged in the chartering of aircraft, the promotion of the air charter business generally or the sale and purchase of aircraft. The permanent headquarters of the association will be established in Paris, but until accommodation is available the administrative headquarters will be : c o E. A. Gibson and Co., Ltd., Cunard House, Leadenhall Street, London, E.C.3.

At the conference, 30 separate firms gave an undertaking to join the association and 25 more were received by proxy. Until an election of members to serve on the Council, a temporary committee will continue in office.

HOW ARE YOUR LOOPS?

THE Guild of Air Pilots and Air Navigators has announced a revision of the arrangements by which it formerly issued flying instructors' certificates endorsed to exclude aerobatics. Previously the Guild has given a concession when granting certificates to pilots who were unable to qualify on aircraft possessing an aerobatic category. The G.A.P.A.N. Examining Panel has always considered, however, that aerobatics are an essential qualification for an instructor, although it was realized that in the post-war period it would often be difficult, if not impossible, for candidates to obtain this experience. It is now believed that better facilities exist and, accordingly, all future candidates will have to satisfy the Panel of their competence to perform and explain all standard aerobatics. The Assistant Instructors' Certificates will continue to be issued with the aerobatic limitation, but those applying for the full certificate will have to qualify in these manœuvres and will be tested on their ability to perform them.

A "TOURIST" SEATING DESIGN

NOW that plans for tourist-class air travel are being discussed on an international plane by the world's airlines, the important question of aircraft seating design has claimed high priority among operators' current problems. The basic requirement is, of course, to adapt airliners to carry more passengers in an adequate degree of comfort but with less individual luxury. In this direction Britain is by no means backward, and already, after consultation with the Corporations and the A.R.B., Vickers Armstrongs, Ltd., have designed and built a number of special lightweight seats which will probably be fitted in a number of British high-density aircraft.

Both light and compact, the seats are built in blocks of two and three, the intention being to install them five-seats-abreast across the cabin. They are stressed to 15g and can be used facing forward or rearward.

Construction is of molybdenum steel tubing and weight is further reduced by using rubber-foam padding, with a moulded head-rest and cushion. A small folding table and an ashtray are fitted to the back of each seat for the use of the passenger sitting behind. Four different reclining positions are provided, and can be selected at the touch of a button. Both the Corporations and a number of foreign operators are reported to be already studying this type of Vickers seat.

Space and weight-saving are, of course, prime requisites for successful "tourist" operation and it has been estimated that, on an average, every unnecessary pound of weight means, in terms of cash, a loss of £27 per aircraft per year. Thus, if an operator were to carry an extra 2 lb cushion on each of the 60 seats in a fleet of 20 aircraft, the average annual loss would amount to almost £68,000. This calculation is based on the utilization of 2,000 hr a year and a stage speed of 200 m.p.h.

B.O.A.C., incidentally, are expected to open tourist services with 68-passenger Constellations and there is also a possibility that there will be a 100-seat version of the Bristol 175.

AUSTRALIA'S FINANCIAL DIFFICULTIES

THE latest Australian Budget, and the ten per cent overall reduction in Commonwealth Public Services which it implied, has created serious problems for the country's Department of Civil Aviation and in some quarters it is even thought that the development programme planned for Australian airfields will be considerably retarded, especially in certain country districts.

The present personnel strength of the Department (5,300) is to be reduced immediately by 500 and the Budget provision for its activities has also been reduced by £500,000. The major programmes whose implementation will probably be delayed are expected to be : (a) the siting of 79 D.M.E. stations; (b) the installation of 13 I.L.S. systems; (c) a number of improvements in V.H.F. coverage on existing airline routes; and (d) the building of a modern telecommunications centre at Mascot, with tape relay equipment, to improve the present communications facilities on international services.

The construction of urgently needed terminal buildings at major airports will also be delayed and the development of many country airports for internal services will be postponed indefinitely. In view of the constant increase in passenger and freight traffic in Australia, a reduction of administrative personnel without impairing the standard of safety is likely to prove a considerable problem. Special efforts are being made to induce the Government to change its plan, at least to an extent which would allow the navaid development programme to be put into effect, as this would obviously play a vital part in any national air defence scheme.

The Department, incidentally, has published some traffic statistics for the quarter ended March 31st which appear to lend weight to the Australian Prime Minister's recent announcement that his Government had decided to retain the principle of competition on internal routes between the state-owned T.A.A. and the privately owned A.N.A. On the Sydney-Melbourne run, for the period under review, A.N.A. carried 23,935 passengers and

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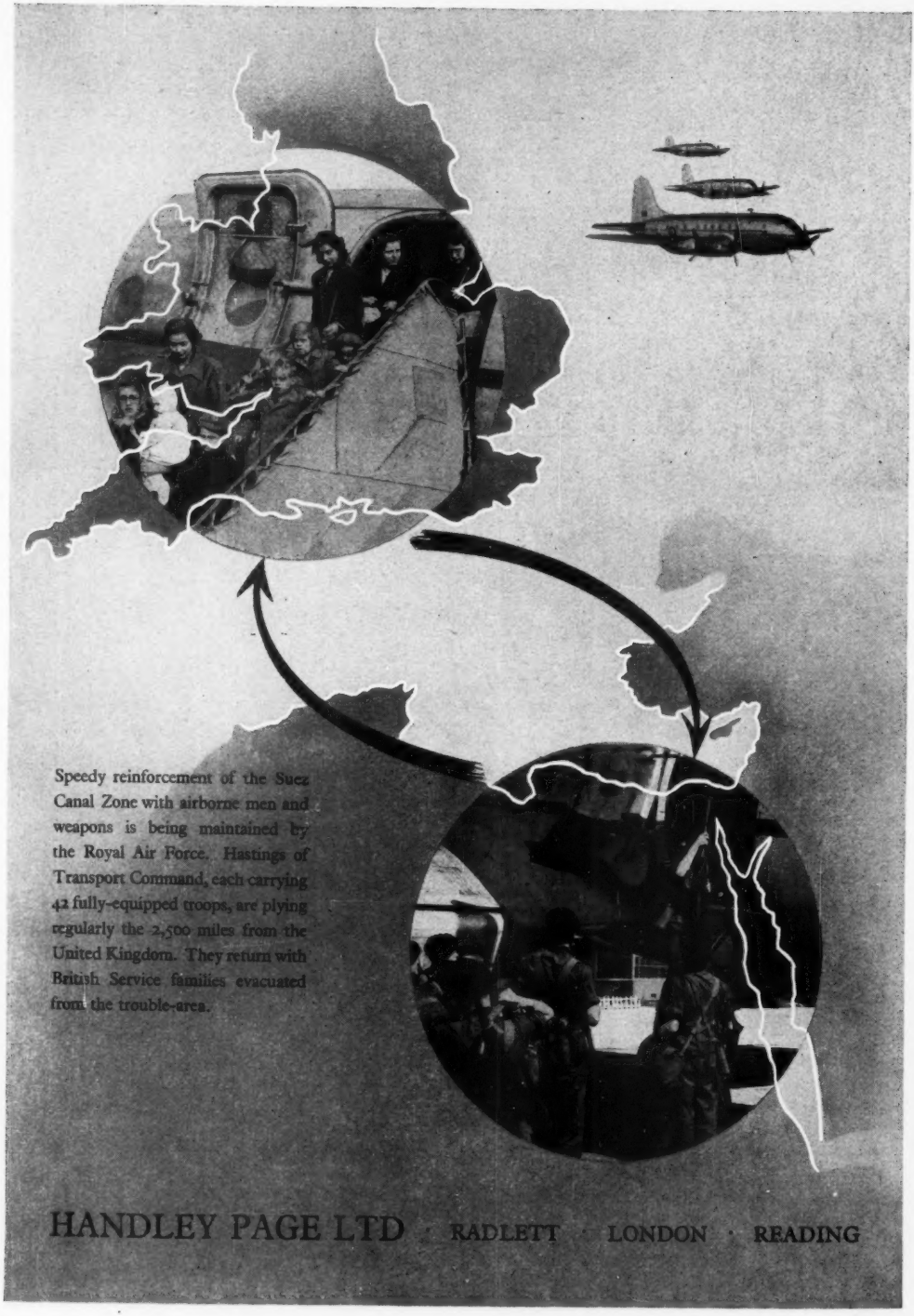
Speedy reinforcement of the Suez Canal Zone with airborne men and weapons is being maintained by the Royal Air Force. Hastings of Transport Command, each carrying 42 fully-equipped troops, are plying regularly the 2,500 miles from the United Kingdom. They return with British Service families evacuated from the trouble-area.
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CIVIL AVIATION . . .

1,159 tons of freight, while T.A.A. carried 27,351 passengers and 440 tons of freight. Expressed as totals for all routes on which services are operated by the two companies in direct competition, the results are: T.A.A., 155,732 passengers; A.N.A., 149,207. On all routes, however, A.N.A. carried 180,771 passengers, 7,002 tons of freight and 45 tons of mail, as compared with T.A.A.'s 178,141 passengers, 3,197 tons of freight and 513 tons of mail.

In a recent statement of the Australian House of Representatives, the Prime Minister, Mr. R. G. Menzies, said it was not part of his Government's policy to foster a monopoly either by the State or by private enterprise. As T.A.A.—initiated by the previous Labour government as a first move towards nationalizing all air services—had been efficiently established the Government considered it desirable that competition should continue so long as it remained fair competition. It has been intimated, also, that A.N.A. will in future be granted a larger share of Government traffic, including mail.

A.N.A. uses mainly DC-4s for its passenger operations and most of the company's freight-work is carried out with a large fleet of DC-3s and some Bristol Freighters. The latter machines are also utilized for the now famous Air Beef Scheme. T.A.A. uses a mixed fleet of Convairliners, DC-4s, DC-3s and D.H. Dragons.

I.A.T.A. DISCUSSES VISUAL AIDS

DETAILED recommendations for the standardization of visual landing-aids for the short but nevertheless vital period between the approach to the runway and the actual touch-down have been studied by I.A.T.A. with a view to presenting them to I.C.A.O. early next year.

A recent meeting of the I.A.T.A. Flight Technical Group at New York evolved a number of specifications for approach lighting and for the lighting and marking of runways and threshold areas at airports. The aim was described as a further step towards complete "on schedule" airline operations in all types of weather. The session concentrated on visual aids to the pilot rather than on electronic devices, as this subject is to be taken up at future meetings.

Passing on studies made by previous sessions, the I.A.T.A. Group concluded that both the Calvert and A.L.P.A. (Air Line Pilots' Association) systems of approach lighting generally met the operational requirements for this form of visual aid. Both have been tested operationally and found satisfactory.

As a basic recommendation, the meeting agreed that standardization of visual aids is necessary if airlines are to lower their operating minima. While encouraging the search for further improvements to visual aids, however, the Group also stressed the fact that care must be taken to ensure that any resulting alterations should not cause confusion with standard systems or be proposed for worldwide adoption until they had been widely tested under operational conditions. The Group felt that "marking" was particularly necessary to increase the distance at which the runway could be picked up; to help the pilot to judge height and distance along the runway; to give him accurate horizontal guidance when his aircraft was close to the ground or taxying; and to give "roll" indications when the actual horizon was obscured.

In terms of what a pilot coming in for a landing would see at a time when ground markers were visible, I.A.T.A.'s recommendations for threshold marking include (i) a "threshold block" at the beginning of the runway, made up of painted strips at least 125ft long and at least 9ft wide, running in the direction of the runway itself; (ii) a broken line of markers and blank spaces, each 100ft long and at least 3ft wide, down the centre of the runway for its entire length; (iii) further markings down the runway, approximately 75ft on either side of the centre line and made up of a continuous, but not necessarily solid, line about 5ft in overall width.

The provision of approach, threshold and runway lighting systems is recommended as follows:—

Approach Lighting.—A single row of high-intensity approach lights spaced 100ft apart along a 3,000ft extension of the runway centre line (these could be either point sources or short bars—if the former, they would be supplemented by large, lighted crossbars every 500ft); an indication of distance at a point 1,000ft from the threshold.

Threshold Lighting.—A bar of red warning lights 200ft from the threshold, supplemented by two side bars of red lights at least 14ft long, extending at right angles from the side of the pre-threshold area at a point 100ft from the start of the runway; threshold bars of green lights extending at right angles from the ends of the runway, and each at least 40ft long (these could be continued across the runway itself if the lights could be arranged so as not to be an obstruction); a closely spaced line of green lights down the side of the runway from the threshold for a distance of 200ft.

Runway Lighting.—A further system of wide-angle high-intensity runway lights spaced along the sides of the runway at intervals of 100ft along the 2,000ft touch-down area and at intervals of not more than 200ft (and preferably 100ft) for the rest of the runway.

After approval by I.A.T.A.'s Technical Committee, the recommendations will be forwarded to I.C.A.O. as suggested standards for implementation by all governments concerned.

GERMAN ATLANTIC AIRLINE?

IN the opinion of Mr. Ralph Damon, president of T.W.A., who recently visited Frankfurt, Western Germany could, without much difficulty, re-establish transatlantic air services. This would be done with a capital of about £3,500,000, all of which could be found in Germany itself. As far as he knew, however, discussions on the prospects of reforming such a company to take the place of the pre-war Lufthansa were still purely speculative.

It is generally agreed that permission for the Germans to engage in air transport activities once again will almost certainly be included in any new agreement negotiated by the Bonn Government to replace the present system of control under the Occupation Statute. There are, indeed, rumours that the Germans have already started negotiations with at least one foreign company with a view to starting a pilot training programme; these, however, have not been confirmed.

Mr. Damon is of the opinion that for £3,500,000 Germany could buy a fleet of about half a dozen aircraft which would be capable of maintaining transatlantic schedules. It is believed, he said, that if and when the Germans return to transatlantic aviation they will probably concentrate first on South American routes, where the Lufthansa was well entrenched before the war.

AUTOMATIC LANDINGS

UNITED AIR LINES has placed an order with the Bendix Aviation Corporation for the installation of the new Bendix flight-path control system for automatic landing approaches. The device will be fitted on 44 DC-6s and 20 DC-6bs. Briefly, the principle of the system, which is designed to permit normal landing, is that it automatically orientates the aircraft between two radio beams transmitted from the destination airport. The aircraft-borne installation is tied-in with the autopilot and the aircraft first aligns itself automatically to fly towards the airport and then, following given distance and position signals, maintains a steady approach to the runway. The pilot completes the landing when V.F.R. conditions are reached.

FOR AFRICAN CHARTERS: Noon and Pearce Ltd., a company operating non-scheduled flights from Nairobi West Airfield, recently received Beechcraft Bonanzas to replace the Geminis which were formerly used. The machines are proving popular with both operators and passengers; with the former because of their efficient performance and increased cruising speed at high altitudes, and with the latter because of the standard of comfort, luggage capacity and low noise-level.

CIVIL AVIATION . . .

THE CORPORATIONS' RECORD MONTH

THE volume of passenger traffic carried by U.K. airlines in August was, for the third successive month, the highest on record. Nearly 200,000 passengers were carried and 114,000,000 passenger-miles flown during the month. B.O.A.C. accounted for 68,000,000 passenger-miles, a 34 per cent increase on the figure for August, 1950, while B.E.A.'s total of 44,000,000 passenger-miles was 31 per cent better than that for the corresponding month of the previous year. Another notable achievement was the 81 per cent passenger load-factor achieved by B.E.A.'s British Division as compared with one of 66 per cent for August, 1950.

I.C.A.O.'s SECRETARY-GENERAL

AS mentioned briefly in these pages last week, the Council of I.C.A.O. has appointed as secretary-general to the organization Mr. Ernst Carl Robert Ljungberg, director-general and president of the Royal Board of Civil Aviation in Sweden. The selection was made after the qualifications of many outstanding and experienced candidates had been considered. Mr. Ljungberg will succeed Dr. Albert Roper, first secretary-general to both the provisional and permanent organizations, who has notified the Council of his intention to retire this year. The duties of the secretary-general, who holds a five-year appointment, include the administration of a permanent secretariat of some 400 international employees working at I.C.A.O.'s headquarters at Montreal and in the field offices of Paris, Cairo, Lima and Melbourne.

Mr. Ernst Carl Robert Ljungberg.

Born in 1897, Mr. Ljungberg was a student and lecturer of the Royal Academy of Artillery and Engineering and has also served as an officer in the Swedish Signal and Engineers Corps and as a member of the Swedish General Staff. He has long been active in all fields of aviation, and in 1946 was elected chairman of P.I.C.A.O.'s Technical Commission; in 1950 he became chairman of the Economic Commission at I.C.A.O.'s Fourth Assembly. He is a member of both the Swedish Institute of Aeronautical Research and the Council of Meteorology and Hydrography.

BREVITIES

REPLYING to a question in the House of Commons last week, the Minister for Civil Aviation, Mr. John Maclay, said that it was intended to introduce a regular air service between Manchester and London in April, 1952.

* * *

K.L.M.'s Traffic Division announced last week that for the first time in the company's history, the total of 1,000,000,000 revenue passenger-kilometres has been exceeded in a year.

* * *

Because of a temporary shortage of aviation fuel in Cyprus, K.L.M. aircraft which, for the last month, had been refuelling at Nicosia instead of at Cairo, now land at Damascus for this purpose. The shortage is believed to have been caused by R.A.F. stockpiling of fuel for use in the eventuality of another airlift of British troops to the Canal Zone.

INAUGURAL OCCASION: To commemorate the first direct scheduled B.E.A. Service between London and Hanover, the Mayor of that city, Herr K. Wiechert, handed to the pilot of the aircraft a letter of greeting and a book of photographs of Hanover for delivery to the Lord Mayor of London, Sir Leslie Boyce. The Lord Mayor is seen receiving the package from a B.E.A. traffic clerk at the Mansion House on November 20th.

The de Havilland Aircraft Co., Ltd., have now confirmed the rumours—which we reported last week—that negotiations have been under way for the purchase by Air France of three Series 1 (Ghost-powered) Comets. They add that a purchase-agreement in principle, subject to the formalities of French Government approval, has been signed.

* * *

Two technical observers from P.A.W.A. are to visit Britain shortly to make a preliminary survey of the engineering, flight and maintenance work now being carried out by B.O.A.C. on the D.H. Comet. They are Capt. Scott Flower, superintendent of P.A.'s Operations Engineering Division, and Mr. George W. Taylor, maintenance manager of the Atlantic Division.

* * *

A. V-M. D. C. T. Bennett has sold his privately owned charter company, Fairflight, Ltd., which has recently been operating two aircraft—a Tudor and a Lincoln—on the so-called second "Berlin Airlift." The company has been acquired by Surrey Flying Services, Ltd., whose operations are carried out principally from Stansted and Blackbushe.

* * *

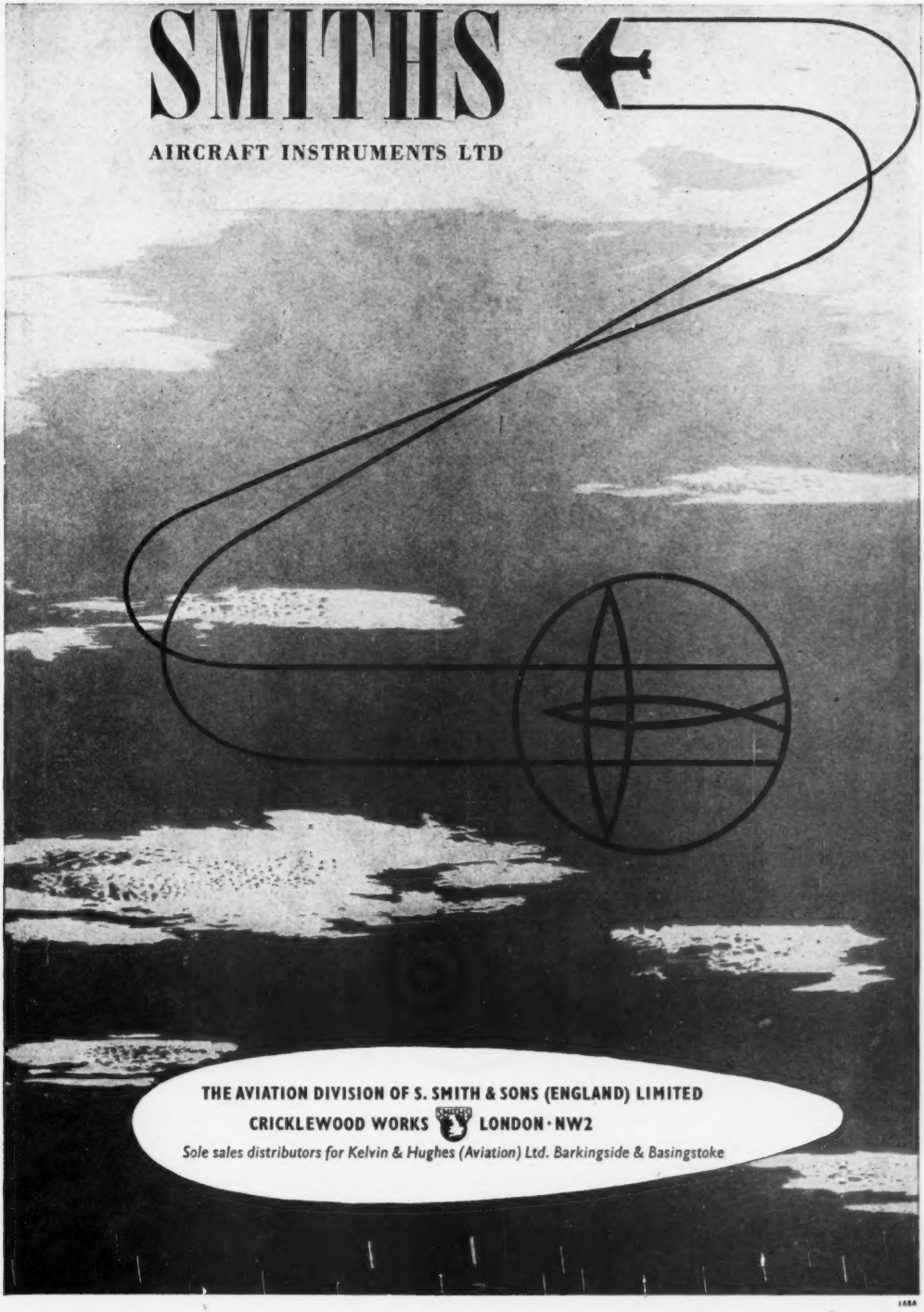
For the financial year ended June 30th, Australian airlines carried a record amount of traffic in both passenger and freight categories on almost every route in the Commonwealth. Passengers totalled 1,727,691, as compared with 1,541,277 in the previous year, and freight reached 53,482 tons, as compared with 44,549 tons. The passenger load-factor, taken as an average over 16 operating companies, was 64.6 per cent. On overseas services the passenger total rose sharply from 26,115 in 1950 to 40,468 in the year under review.

* * *

Influenced by operational considerations and by the fact that the Egyptian Government is now imposing certain restrictions on air passage to Israel for aircraft overflying in Egyptian territory, South African Airways has decided to re-route its Springbok service between Johannesburg and London *via* Khartoum instead of Lydda. For an indefinite period, therefore, El Al will be the sole operator on the route between Lydda and South Africa, and in order to meet the traffic requirements of the route the company has increased to weekly the frequency of its service between the two countries. In future, also, El Al's Constellations will probably stop at Entebbe instead of Eastleigh.

* * *

The U.S. Weather Bureau has established a broadcasting service exclusively for the use of private pilots. Weather forecasts lasting from three to seven minutes and run from tape recordings are broadcast continuously in much the same way as the time service can be dialled on the British telephone system. A number of pre-tuned receivers have been installed at airports in the areas covered, but any pilot can obtain the service by tuning in his own set to the frequency. The new service is intended to overcome the delays which were caused by the fact that meteorological sections were unable to handle the large numbers of telephone requests for forecasts. At La Guardia airport, for example, in bad weather, as many as 600 calls a day have been received.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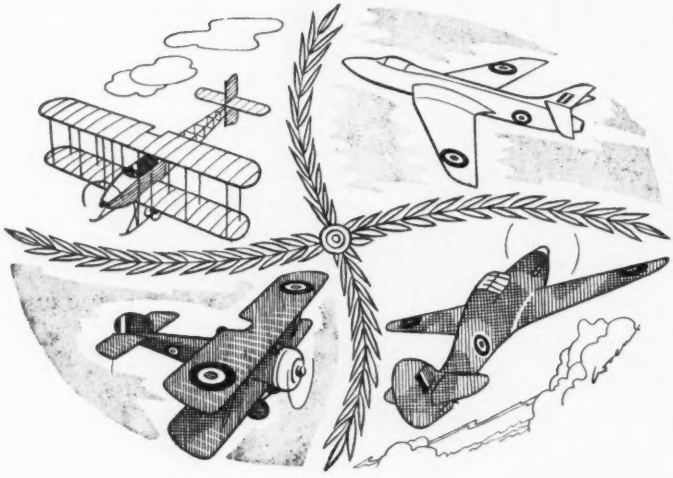

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CIVIL AVIATION . . .

TOWARDS CHEAPER FLYING

LAST week, long-suffering British private and club flying enthusiasts heard, probably with some disappointment, the official announcement from Londonderry House of the A.B.A.C.'s scheme for the formation of business firms' flying clubs.

The idea—by no means a new one—is that firms' welfare facilities should be extended to private recreational flying for their employees at conveniently situated "air centres," and at rates considerably below those normally charged by clubs. The residual proportion of the flying costs would be contributed by the company concerned and, by arrangement with the Department of Inland Revenue, would then be allowed as welfare expenditure in computing the firms' taxable profits.

To those who expected the announcement to be of somewhat more far-reaching significance (for example, a direct subsidy), the A.B.A.C. scheme will, as we have indicated, probably have come as something of an anti-climax. Reference to the scheme is contained in our leading article, and we therefore publish here a brief resumé of the way in which the scheme is intended to work.

In point of fact, a somewhat similar arrangement has been in existence for some time for members of the flying clubs run by several large firms. Among them, admittedly, however, were several aircraft manufacturing companies which were able to own and operate their own aircraft. Hitherto, the high capital outlay involved has prohibited smaller firms from providing the same facilities. Under the scheme suggested they will now be able to extend or inaugurate facilities in this direction on a scale consistent with their own resources. Once the employer has agreed in principle to contribute towards the costs, flying enthusiasts among the employees may organize themselves into a club. This may consist of both flying and non-flying members. In respect of the latter, the fact that a proportion of the employers' grant may be set aside to augment the non-flying members' subscriptions and provide them with one or two recreational flights a year without charge should considerably widen the scope of the individual club.

Flying facilities will, it is hoped, be arranged at the nearest airfield at which a school already exists, and from that point onwards the rate at which the employee would be able to fly is purely a matter of apportionment between the firms' grant and the individual contribution. If the companies already have sports or social clubs, it is merely necessary to form an additional flying section. The A.B.A.C. has drawn up model rules which meet both cases and embody provisions agreed by the Inland Revenue Department; these rules are available free of charge to clubs joining the Association as affiliate members.

Probably the easiest way to describe the financial side of the scheme is to cite the system of payment instituted by the flying section of the Rotax Sports and Social Club, the first to be brought under the present arrangement. The employee pays 15s per flying hour, the remainder being found from the firm's grant. The annual subscription of the "air centre," and fees for examinations and licences, are paid by the employee. For the sake of convenience a voucher system has been introduced by which members purchase 5s vouchers, each valid for 20 min flying. These are presented to the "air centre" and one portion returned by the "centre" to the club secretary with a weekly statement of flying.

For fuller details and recommendations as to how the scheme may be operated with the greatest degree of efficiency, firms intending to take advantage of the arrangement are advised to apply direct to the Association of British Aero Clubs and Centres, Londonderry House, Park Lane, London, W.1.

FROM THE CLUBS

THE West Riding Aviation Centre's annual dinner and dance is to be held on Thursday, December 20th, from 8 p.m. until 1 a.m., at Yeadon Airport. A bar extension has been applied for to enable "refuelling" to continue after normal working hours. Tickets are obtainable on application to the secretary, Capt. Worrall, at Yeadon Airport (Rawdon 172), price 10s each.

FROM the beginning of the year until the end of October, the Southend Flying School had logged over 1,740 hours. Some 20 pupils are now undergoing training and eight of them have already soloed. Ten Private Pilots' Licences were awarded to members this year and one member, Mr. Brian Neely, was even ambitious enough to gain his commercial licence. One of the School's several women enthusiasts, Miss Pickett, who qualified last July, has now joined the W.R.A.F.V.R., and Miss Harding, who also recently obtained her licence, is intending to join shortly.

Most of the club's flying this year has been carried out on three Austers, which represents a considerable utilization achievement. Unfortunately the Dart Kitten which the club borrowed with the intention of making it available for only 30s an hour was plagued by protracted periods of engine trouble and little flying was therefore possible. It has since been returned to its owner.

DURING October the London Aeroplane Club, which operates from Panshanger, logged some 160 hours' flying, bringing the total for the first ten months of the year to 1,644. Of the thirty pupils now receiving instruction, ten are already well on the way towards gaining their Private Pilots' Licences, but the others have not yet soloed. Since the beginning of the year, no fewer than 23 licences have been awarded to club members.

One of the major factors contributing to the popularity of the London Aeroplane Club is that it offers flying on a particularly wide range of light aircraft, amongst them Chipmunks, Moth Minors—one of which is the unusual *coupé* version—Tigers and Austers. The Chipmunks, incidentally, are available for only 3s an hour more than the rate charged for Tigers and Austers.

The club's Christmas Party is being held at Panshanger on Friday, December 14th, starting at 6.30 p.m. Tickets, obtainable from the secretary, are priced at 10s each, including dinner. Accommodation is limited, so early application is advised.

LIGHT-AIRCRAFT RADIO

The Plessey Co. Ltd., Ilford, renowned for many years as manufacturers of radio equipment, are now producing an improved (Mk 2) version of the PTR.61 V.H.F. set with which many operators of light and medium aircraft are already familiar. Among the major improvements are a noise-limiter circuit, designed to eliminate interference from magnetos and other electrical units, and the incorporation of automatic tuning in the remote control unit. The output of the set has been increased and a number of other modifications combine to give better reception at extreme ranges. The price is about £210, or £235 with remote control. The complete set is shown (left) together with a remote controller. An idea of its size can be obtained from the installation in a Gemini.

SERVICE AVIATION

Royal Air Force and Naval Aviation News

Malaya's Kiwis Leaving

AFTER two years of eventful flying in and around Malaya, No. 41 (Transport) Squadron detachment of the R.N.Z.A.F. is returning home to re-equip.

The New Zealanders have been flying alongside the R.A.F. and the R.A.A.F. on supply-dropping, communications and other vital work in connection with the Malayan bandit campaign. In addition, their Dakotas have been familiar and welcome workers on Service transport routes stretching to Pakistan in the east and Japan in the west. Now the Dakotas are to be replaced with Bristol Freighters, and the unit is to rejoin its parent squadron at Whenuapai, Auckland. Whether New Zealand will send a replacement unit to Malaya has not yet been decided. The detachment arrived in Malaya in September, 1949, and, during the two years that have followed, it has flown 4,910 hr, an average of 204 hr per month.

The unit has taken its turn, with R.A.F. and R.A.A.F. transport squadrons, at dropping supplies to the Army and police patrols operating in the Malayan jungle against the terrorists. In addition, more than 625,000 lb of supplies were parachuted into the jungle in 211 aircraft sorties.

The supplies ranged from routine pack-ups of food and ammunition to such unusual items as collapsible boats and outboard engines, explosives, barbed-wire, metal sheeting and sacks of rice to feed isolated Sakai (aboriginal) tribesfolk.

Normally the Detachment has been based at R.A.F. Changi, Singapore, although it spent four months at Kuala Lumpur, flying supply-dropping missions from there.

The Detachment formally "wound up" its affairs on November 23rd with a dinner at a Singapore hotel, attended by senior R.A.F. officers and the C.O.'s of Station Wings at Changi associated with their past two years' work.

CHEQUERED: A very pretty piece of "echelon starboard" by pilots of No. 19 Squadron.

Command Boxing Results

AT the boxing contest held at Benson, Oxfordshire, on November 22nd, between Bomber Command and Fighter Command the latter won with 21 points to Bomber Command's 16 points.

On the same day Coastal Command met Home Command at St. Eval, Cornwall. This contest was won by Coastal Command, which scored 20 points to Home Command's 18 points.

Badge for S.U.A.S.

SOUTHAMPTON University Air Squadron was presented with its badge on Friday last by A. Cdre. R. Coats, A.O.C. No. 62 (Southern) Group; S/L. A. J. Hill, commanding officer of the unit, accepted the framed copy (picture on page 669.)

The badge depicts a red hart—part of the armorial bearings of University College, Southampton—standing in front of a pillar, which is part of the badge of Home Command. The motto is *Fortibus Adrua Cedunt* ("Difficulties yield to gallant men").

S.U.A.S. was first formed in 1941, but for its first five years only ground training and air experience was given. It became a flying unit in September 1946 and at that time used Worthy Down. Two months later a move was made to Eastleigh. Flying equipment then comprised one Tiger Moth and one Oxford; later the unit got five Tiger Moths and transferred to Hamble.

The new headquarters were completed in 1949 and in October, 1950, the squadron was re-equipped with Chipmunks. Present strength is 49, including eight regular technical officers. During the past two years 13 members have been granted permanent or short-service commissions.

CANAL PATROL: Vampires pass an Esso tanker proceeding through the Suez Canal.

R.A.F. Yacht Club Moves

THE move of the R.A.F. Yacht Club from Calshot to Hamble is practically complete and the club is to re-open on December 1st at Riverside House, Hamble.

The new premises provide an adequate lounge bar and snack bar combined with dormitory accommodation for both men and women. It has been redecorated and looks very attractive, standing as it does in extensive grounds with lawns stretching to the water's edge. By a permanent arrangement with Port Hamble, Ltd., the whole of the landing facilities and causeways are available to members. Services, with petrol, oil, chandlery and adequate supplies, are available on the spot at all times. The club has been fortunate in acquiring moorings between piles for members and visiting yachts.

Landing facilities on Hamble airfield for communication aircraft up to the size of Anson or Oxford have been generously offered by G/C. Barton of A.S.T.

Next season the club expects to commission two X boats.

Since the news of the move the club became known, there has been a lively increase in applications for membership. The address of the club is Riverside House, Hamble, Hants (Hamble 3278).

Q.U.A.S. Tenth Anniversary

IN the City Hall, Belfast, on November 16th, the Queen's University Air Squadron was entertained to dinner by the City of Belfast to celebrate the squadron's tenth anniversary.

The Lord Mayor of Belfast, Councillor J. N. Norritt, presided over a gathering of some 60 members and ex-members of the squadron. The Lord Chief Justice of Northern Ireland, Lord MacDermott, attended in his capacity of Pro-Chancellor of Queen's University. Other guests included A. Cdre. A. R. Churchman, chair-

From: British Overseas Airways Corporation
To: The President, Executives & Work-people of CANADAIR LIMITED
This Scroll is to place on record the deep appreciation of British Overseas Airways Corporation for the splendid effort made by Canadair Limited in manufacturing and delivering the fleet of 22 Canadair aircraft, eight months in advance of the contract date. By so doing they have made a memorable contribution to the development of air transport within the British Commonwealth.
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Chairman
Secretary
G-ALRC

Scroll presented to Canadair on completion of the original order.

Vignettes of CANADA—AIR LAND
The filming for one of the world's biggest map-making jobs has just been completed by the Royal Canadian Air Force. Begun in 1921, the quarter-century achievement of photographing Canada's three and a half million square miles on aerial film has added another chapter to Canadian history in the skies.
Almost every bit of Canada is now photographed . . . providing a super-accurate source for maps . . . vital information for water power development, mineral exploration, town planning, agricultural irrigation, lumber and pulpwood estimates, as well as a host of other development uses.
The job, started in the early 'twenties, is another Canadian air-pioneering first — chalked up by the R.C.A.F. Transport Command.

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For further information:
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SERVICE AVIATION . . .

man of Belfast and Antrim Territorial and Auxiliary Forces Association; A. Cdre. H. J. G. E. Proud, A.O.C. No. 67 Group; G/C. D. I. Coote, Station Commander, R.A.F., Aldergrove; Professor J. L. Montrose; W/C. I. C. Jackson, S.A.S.O. No. 67 Group; and S/L. D. F. B. Sheen, C.O. of No. 502 (Ulster) Squadron, R.Aux.A.F.

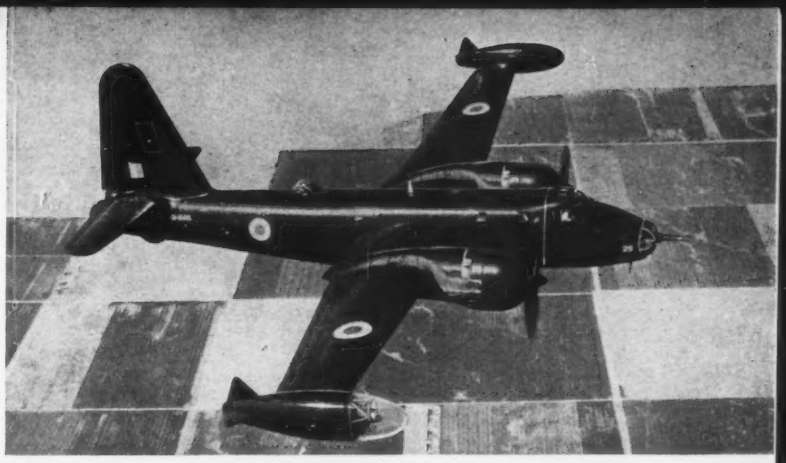
Replying to the toast of the Q.U.A.S., the commanding officer, S/L. J. A. Brignell, thanked the Lord Mayor for the honour shown—one which he believed to be unique, in that the University Air Squadron was the first unit of its kind to dine within the precincts of the City Hall. He also read a telegram which had been received from the A.O.C-in-C. Home Command, Air Marshal J. D. I. Hardman, in which the Air Marshal expressed his regret at being unable to attend owing to illness, but said that he wished the Air Squadron "a happy and successful party." In his reply the commanding officer also stressed the value of the University Air Squadron in enabling students from different faculties to mix together with a common interest, and also to place their feet very firmly on the rungs of the ladder of a career in the Royal Air Force.

R.A.F. Range in Cornwall

CORNWALL COUNTY COUNCIL was one of 22 objectors at an inquiry, held at Truro early this month, into the proposed use of land and sea areas at Penhale Sands for R.A.F. training.

For the Air Ministry it was stated that two range areas were needed, one having a depth of seven nautical miles and another of 5,800 yd. No explosive ammunition would be fired and shipping might pass through the area, but must not loiter. Subject to War Office conditions, the public had a right to enter the area when it was not in use.

The objectors referred to the fact that 9,000 acres and 13 ranges were already in Service use in Cornwall—more, it was thought, than the county's fair share. The other principal objections were on account of noise, of the closing of the northern part of Perranporth beach and of the interference with the present trawling and crabbing grounds.



ROUNDELS OVER CALIFORNIA: One of the new R.A.F. Neptunes on a test flight from the Lockheed factory at Los Angeles. In this view are seen clearly the nose and dorsal armament and the radar scanner on the starboard wing-tip.

Camrose Trophy Awarded

ON Tuesday of last week Air Chief Marshal Sir Hugh P. Lloyd, A.O.C-in-C. Bomber Command, accompanied by A. V-M. D. A. Boyle, A.O.C. No. 1 Group, visited R.A.F. Station Hemswell to present the Gardens Trophy to the Station and the Camrose Trophy to No. 109 Squadron.

Addressing the airmen, Sir Hugh pointed out how important was horticulture and farming to the economy of the R.A.F. Over 2,500 acres are under cultivation, producing vegetables to the value of over £250,000. "The income from the pigs," he said, "had to make up for the pre-war N.A.A.F.I. rebate, which provided most of the Service's sports equipment."

Turning to the Camrose Trophy, which is now offered for competition between light marker squadrons, the C-in-C. said it gave him especial pleasure to make the presentation because "bombing is our business." He pointed out to the assembled company that it was not only the bomb-aimers who "put the bomb on the pin," but that every member of the Command made his contribution to the result.

He emphasized his point by reminding his listeners that the effectiveness of a bomb diminished as the square of the distance from the target. Therefore, if the mean bombing error of the Command were halved, then one squadron would serve in place of four, one production line in place of four lines, and one tanker in place of four tankers; and casualties would be cut to a quarter. Such an improvement, he concluded, would constitute the biggest single contribution possible to the national defence.

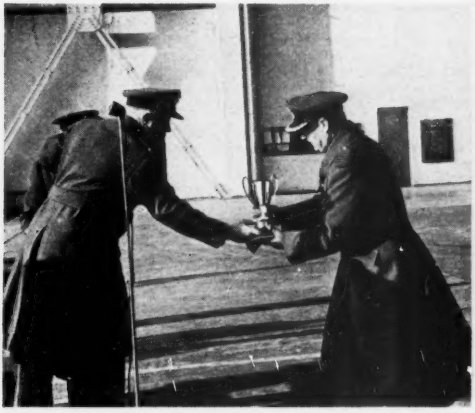
Sir Hugh then presented the Gardens Trophy to G/C. J. M. Warfield, the Station Commander at Hemswell, and the Camrose Trophy to S/L. D. T. Witt, who commands No. 109 Squadron.

The Camrose Trophy is in the form of a silver model 12,000 lb "super block-buster" and was originally presented to No. 5 Group in 1944 by Lord Camrose as a mark of appreciation. It was then awarded for high-level bombing and was won twice by No. 50 Squadron and four times by No. 9 Squadron.

R.O.C. Airport Liaison

A MEMBER of the Royal Observer Corps since 1933, Obs/Lt. G. A. D. Bourne has been appointed liaison officer at London Airport. Communications should be addressed to him as "R.O.C. Liaison Officer, London Airport, Feltham, Middlesex."

FOR GOOD AND ACCURATE PLANTING: (Left) Air Chief Marshal Sir Hugh P. Lloyd presenting the Gardens Trophy to G/C. J. M. Warfield at Hemswell. (Right) S/L. D. T. Witt, D.S.O., D.F.C., D.F.M., with some of No. 109 Squadron aircrew after being presented with the Camrose Trophy. *(See "Camrose Trophy Awarded," on this page.)* "Flight photographs



CORRESPONDENCE

The Editor of "Flight" does not hold himself responsible for the views expressed by correspondents in these columns; the names and addresses of the writers, not necessarily for publication, must in all cases accompany letters.

Service Family

IN a recent issue of *Flight* you announced a change in the command of No. 615 (County of Surrey) Squadron, R.Aux.A.F.—the Churchill Squadron—and the appointment of S/L. F. B. Sowrey as Commanding Officer.

Those of your readers interested in aviation families may like to know that S/L. F. B. Sowrey is the son of G/C. Fred Sowrey, D.S.O., M.C., A.F.C., who shot down Zeppelin L.32 at Billericay in September, 1916.

The latter has two brothers, the younger one being A.Cdre. William Sowrey, C.B.E., D.F.C., A.F.C., late A.O.C. East Africa. The elder one is A.Cdre. John Sowrey, A.F.C., F.R.Ae.S., whose children are: S/L. J. A. Sowrey, D.F.C., serving at the Empire Test Pilots School, Farnborough; P/O. J. A. F. Sowrey, late of 615 Squadron, killed in action while flying Hurricanes in the Western Desert in 1941; F/Cdt. W. R. Sowrey, R.A.F. College, Cranwell; and Miss E. M. Sowrey, who served in the W.A.A.F. from 1939 to 1945.

All three Sowrey brothers of the "old vintage" commanded squadrons in the field in the 1914-18 war, and each was awarded the A.F.C.

Middlesex. PER ARDUA.

[This must surely be an all-time R.A.F. record, especially in respect of the high ranks of the officers concerned, and distinguished service indicated.—ED.]

"Modern Montgolfier"

IN reply to the several well-founded criticisms of my article under the above title (*Flight*, November 2nd) let me first of all explain that I merely offered a subject for discussion, and it appears to have succeeded.

Generally, the criticisms agree that the "Thing" would rise, but not so high, or with such a load, were the envelope closed—which it is not. The critics' mistake lies in dealing with the matter as a pure-displacement theory rather than as one concerning a projectile. The gases are not trapped in the shell, but are in a state of motion. There is no flexible bag within the shell. Admittedly, the differential pressure would appear to create a tremendously difficult point in design, such as to restrict altitude and load.

Let me say I agree with Mr. G. R. Barrett (November 16th) that the "Thing" is practically worthless, but so are most weapons.

With tongue-a-little-in-cheek I relish the possibilities of such a device being in use (empty!). Personally, I have never seen one, but others insist on the bullet-shape, the glowing shell and the speed characteristcs. Perhaps someone would like to shoot down this revised "saucer" theory in discussion?

Tolworth, Surrey. L. ARTHUR.

Defence Dilemma

THE serious position regarding manpower which confronts aircraft manufacturers in this country was ably illustrated by Sir Guy Garrod in the speech reported in your issue of November 9th, and I would particularly wish to enlarge on the aspect of producing machines and equipment for abroad to which he also referred.

If we accept the statement that this country at present has a lead of at least five years over the rest of the world in turbojet and turboprop aircraft, then the opportunities for creating a large and permanent export trade are manifest, and the benefits accruing to the national economy would be enormous. To attain this highly desirable state of affairs, however, two factors should be given more sympathetic consideration by the British Government. Defence contracts which aircraft companies have undertaken can, in very many cases, absorb the entire availability of production for years ahead, with the consequent result that delivery periods of materials or machines for foreign countries inevitably suffer. The other point is that, at this juncture when many foreign operators are changing from piston-engined to jet aircraft, they cannot but be unfavourably prejudiced if British suppliers are either unable to provide vital spares or else give such protracted deliveries that satisfactory maintenance of existing machines is rendered difficult.

Though it is true that most companies make strenuous efforts to keep their foreign customers supplied with limited quantities of spares, and so retain goodwill, their endeavours are restricted by the shortage of supplies of raw material and of components manufactured by other firms, and then subjected to the overriding demands of the defence programme. Many important foreign users who before the war flew aircraft constructed in North America or in European countries may well consider reverting to previous sources of supply if they cannot obtain what they want from us in a reasonable period.

The Government would be well advised to make a small relaxation in their immense volume of requirements, so as to enable suppliers to alleviate the difficulties of foreign customers and so perpetuate existing friendly and efficient relations. Failure to take steps to this end may do lasting harm to the aeronautical export industry and offset the technical advantages at present enjoyed.

London, W.5. V. W. WEDDELL.

Naming the P.1067

IN regard to the naming of the P.1067, it appears that a complete lack of inspiration is being overworked to produce a number of unspeakable suggestions. Three types of name should at all costs be avoided:—

(1) Those which attempt to conjure up faded memories. Why associate a modern fighter with an aircraft that is now hopelessly outmoded? Why drag the museum into everyday life? Why rest on fading laurels?

(2) Those which make maudlin reference to political or national aspirations. A nation is never so hollow as when it boasts about its prowess in war.

(3) Those which demonstrate the most abject commercial mentality—a combination of two or more familiar words, clipped and misspelt, arid and insignificant.

Furthermore, what is the necessity for alliteration? Let us not name our aircraft like American cars. That disposes of Hurricane, Hurrifire (horror of horrors) and "H".

Couldn't we fight the fighter and call the 1067 Sickle and the Short bomber Hammer?

The best previous suggestion seems to be Rapier for the 1067. Liquid and plosive make a good onomatopoeic combination for a fighter's name; or even a sibilant and plosive, as in Sickle, cause a pleasant *frisson* without commerce or idealism.

A new fighter must be named, not associated. We depend on the present, not the past.

Oxford. REALIST.

Calling a Halt

REFERRING to your paragraph on names for helicopter passenger stations (page 547, October 26th), may I suggest: ROTA-HALT, HELI-HALT, ROT-HALT, COPTER-ALT (or KOPTERALT), ROTASTAGE.

London, N.5. W. H. REED.

ON the subject of "rotorpodios" (or whatever hideous name is eventually adopted), I want no part in any competition for christening the things. What is more to the point, I think, is to find sites for them; and in this connection I should like to venture the suggestion that the South Bank Exhibition area would offer admirable opportunities. It is adjacent to one of our most important railway termini and within a few minutes' walk of another and the West End. Certainly it would be better to use it for this purpose than to let it become a dreary and apparently everlasting ruin, as has happened to other exhibition sites in the past. It could also, incidentally, be combined with a central coach terminal for B.E.A., whose present station in Kensington High Street is, to my mind, too far from the centre of things.

London, S.W.1. D. ROBINSON.

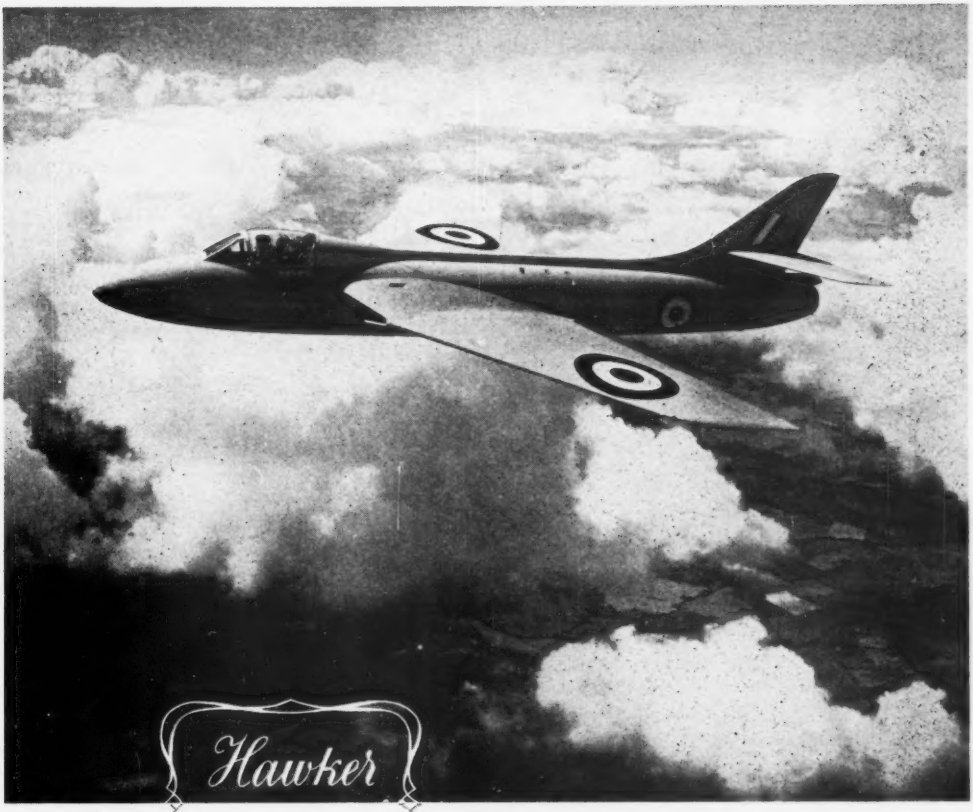
[The original reference was to an announcement, by the then Minister of Civil Aviation, that the term "Airstop" was to be officially adopted.—ED.]

From Canada's Far North

AS a subscriber to your magazine for over a year I have been pleased to see the frequent references to the Canadian aircraft industry and aviation in general. The recent articles by Mr. Frank Illingworth were particularly interesting to me as a resident of Yellowknife.

Only one statement must be challenged. While it makes for colourful reading, the suggestions that local residents mail their laundry to Edmonton does not do justice to the enterprise of Messrs. Buchan and Macara, who established a fully modern laundry and dry-cleaning plant three or four years ago.

However, this is but a minor point. I much enjoy all the material presented and the opportunity to keep up to date with developments in Britain since I left some five years ago. This



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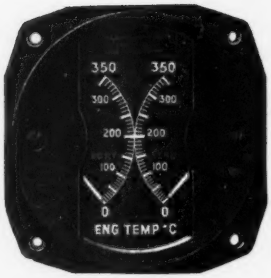
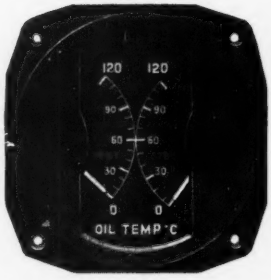


WESTON
AIRCRAFT INSTRUMENTS



Illustrations show:

Above, Model S128. Dual Engine Temperature Indicator, comprising two Millivoltmeters of 100° scale housed in large-size S.A.E. case. For use in conjunction with copper/constantan, iron/constantan or chrome/alumel thermocouples.

Below, Model S127. Dual Ratiometer Indicator, comprising two 100° Ratiometer movements housed in large-size S.A.E. case. For use in conjunction with thermometer bulbs, electrical oil pressure transmitters, electrical position indicators or any combination of two of these to indicate a variety of temperatures, pressures or position.

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CORRESPONDENCE . . .

Northland is so different from the English countryside, yet the airways have indeed brought it close. Air activity is quiet right now, with local operators converting to skis, but the summer months are filled with the coming and going of Lancasters, Cansos and Dakotas on photographic and search and rescue operations. The search for Johnny Bourassa, commented on in another of your recent issues, was regretfully abandoned some weeks ago. His path was followed for some distance by abandoned camp-sites, but all trace was then lost.

The writer took his training in Canada at Calgary and Medicine Hat and later instructed at Moose Jaw and Mount Hope. I was interested by recent mention of the names Dobree-Bell (who as a flight lieutenant gave me the final categorization test at No. 2 F.T.S., Vulcan, Alberta) and G/C. B. K. Burnet, former commanding officer at Mount Hope, Hamilton.

Copies of *Flight* reach me in an average of three weeks by surface mail. Each one is full of interest to while away the long winter evening of the North. Thank you!

Yellowknife, N.W.T. PETER G. WISEMAN.

Hollywood at it Again

AFTER seeing the film *The Flying Leathernecks* I checked up on a few glaring mistakes; for instance, why should a Wildcat squadron be equipped with Hellcats?

Also, in the views of Japanese aircraft, a Navy O Zeke is seen approaching head on, then a view of the cockpit and wing-root shows three guns of unknown calibre grouped together in the wings. There was no Japanese aircraft with six wing mounted guns—certainly not the Mitsubishi AGM5 Zeke. Could you please explain this?

Timperley, Cheshire. B. B. PECK.

[We could not; nor could we explain why bricks much heavier than these are so often dropped in films for which "technical advisers" are said to have been engaged at vast expense.—ED.]

IN BRIEF

Recently re-formed, No. 158 (Braintree and District) Sqn., A.T.C., is in need of books (aviation technical and fiction) with which to build up a library. The C.O., F/L. R. Holland, 1, Gilchrist Way, Braintree, Essex, would be grateful to anyone able to help in this direction.

THE INDUSTRY

RISK-FREE RIVET-MILLING

SINCE drag-reduction is of paramount importance, flush-riveting is now the accepted method of securing the external skins of high-speed aircraft. Even so, the technique is not perfect, for it is not easily possible to ensure that the rivet heads will lie truly flush with the sheet, especially on curved surfaces.

Cleaning-up the heads with an end-milling tool is often resorted to, but an operator using a tool not specially designed for the job can very easily damage the skin-surface itself.

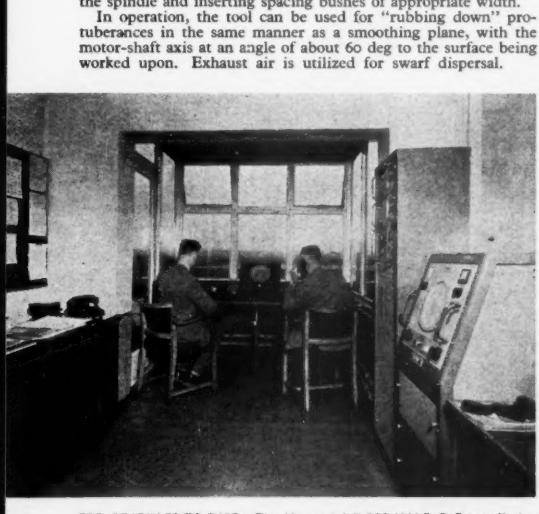
Studying this problem, Short Brothers and Harland, Ltd., have evolved their own rivet-milling tool and made it the subject of a patent application. Intended for use in conjunction with a portable power unit (i.e., a compressed-air-operated hand drill), it comprises a circumferential milling cutter; a cutter spindle; a housing containing bearings for supporting the spindle at right angles to the driving axis; and a bevel-gear drive from the power unit.

Two free rollers, one on each side of the cutter, project very slightly and thus shroud the cutter from contact with the sheeting surrounding the rivet. Although the shrouds extend only 0.0005in beyond the teeth this margin is sufficient to ensure that the cutter operates on the head only.

Varying widths of milling cutter may be fitted by withdrawing the spindle and inserting spacing bushes of appropriate width.

In operation, the tool can be used for "rubbing down" protuberances in the same manner as a smoothing plane, with the motor-shaft axis at an angle of about 60 deg to the surface being worked upon. Exhaust air is utilized for swarf dispersal.

The cutter-head of the Short Bros. rivet-milling tool.



FOR BEARINGS-TO-BASE: The Marconi A.D.200 V.H.F. D/F installation in the de Havilland control-tower at Hatfield, to which we referred in a recent issue. On the right are the master control console and twin receivers; on the control officer's desk are the remote bearing-indicator and twin loudspeakers.

DIRECTORY TO BRITISH INDUSTRY

THE 1951-52 edition of a work of reference which is considered virtually indispensable by executives throughout industry is now available. It is the *F.B.I. Register of British Manufacturers*, the only authorized directory to the firms comprising the Federation of British Industries.

The *Register*, which is distributed to importers, trade commissioners, chambers of commerce, commercial attachés, reference libraries, etc., throughout the world, thus providing valuable aid to Britain's export drive, is classified for quick reference in three languages—English, French and Spanish. Its 882 pages (9¼in x 7¼in) are in seven sections, including *Products and Services*—a buyers' guide to over 6,000 firms classified under more than 5,000 trade headings; *Addresses*—an alphabetical list of all F.B.I. member firms, with the postal and telegraphic addresses and telephone numbers, list of products, and notes on branches; and *Trade Associations*, and *Brands and Trade-names*. Additionally, there is an advertisement section in colour.

In his foreword, Sir Archibald Forbes, president of the F.B.I., says, ". . . overseas buyers may confidently assume that every effort will continue to be made to offer products of high quality and to effect delivery within the stated period."

The *F.B.I. Register* is published at 42s. (post free) by Kelly's Directories, Ltd., and Iliffe and Sons, Ltd., Dorset House, Stamford Street, London, S.E.1.

FOLLAND AIRCRAFT RESULTS

SPEAKING at the annual general meeting of Folland Aircraft, Ltd., held recently at Hamble, Mr. C. L. Hill (chairman) said that the new orders on which they were engaged came within the fields of both aircraft and guided-weapon development, and while most of it was secret, he could say that one item was the development, test, and production of a large guided-weapon test vehicle, an example of which appeared on the Ministry of Supply stand at the S.B.A.C. Show.

Apart from these developments, the company had continued to

NO GANNETS, we trust, were among the bag when Sir Richard Fairey held a shoot over his estate near Stockbridge, Hants. Left to right: Sir Richard, Lord Brabazon of Tara, Vicomte A. O. de Thieusieus (Belgian Ambassador), Mr. Gerald Penney and Sir Joseph Ball

THE INDUSTRY . . .

receive the bulk of its orders from de Havillands, for whom they were making Vampire, Venom and Chipmunk components.

Further production space had been leased at Southampton Airport, and further building had been started at Hamble; here the work included a new process department, an extension to the existing experimental department, the rehousing of the jig and tool drawing office, and an extension to the administrative offices. Extensions to the canteen would give them one of the finest industrial canteens in the country.

Speaking with regret of Mr. H. P. Folland's long and continuing illness, which had compelled him to retire from active control of the company's business (he continues in an advisory capacity), Mr. Hill referred in appreciative terms to the work of Mr. W. E. W. Petter, who from July 1st had assumed the full duties of managing director.

Balance-sheet figures reviewed by the chairman included a profit for the year of £146,362 after providing for all charges, but before taxation.

FAIREY PROGRESS

ADDRESSING shareholders at the recent annual general meeting of the Fairey Aviation Co., Ltd., Sir Richard Fairey, M.B.E., Hon. R.Ae.S. (chairman and managing director), spoke of the special problems facing a firm primarily engaged on producing naval aircraft—problems concerned with the accommodation of complicated weapons and equipment, and with the requirements of shipboard operation. Adopted by the Royal Navy, the Fairey Gannet was now going into production and "was of the greatest importance to the company's future"; there were also good prospects of its being adopted by other navies.

The firm, said Sir Richard, was also busily engaged on new types—including a helicopter—while their work on guided weapons continued to expand—though he was not, of course, permitted to give any details. Some of the weapons were under test on the range in Australia.

In another part of his address he said: "I referred last year to the fact that in our opinion we were carrying too large a share of the cost of research and development. Although we do not begrudge our proper proportion, we have since taken steps to remedy this, as can be seen from the large drop in expenditure under this heading in the accounts. We may have to face a heavier charge than this in the future once a proper balance is restored."

Reviewing the company's overseas interests, Sir Richard said that full control of the Fairey Clyde Co. (now the Fairey Aviation Co. of Australasia Pty., Ltd.) had been acquired; Mr. Ray Purves continued in command. In Belgium, Avions Fairey were doing well under Mr. Ernest Tips, and had just completed their first Gloster Meteor 8, a month ahead of schedule, for the Belgian Government. The Air Survey Group of companies had important new contracts in many parts of the world.

The chairman said that he was still unable to report any settlement of the Company's claims for compensation in respect of the Great West Aerodrome, which was incorporated in the London Airport site.

The review of the balance-sheet showed that after deduction of profits retained by subsidiary companies, there remained a net profit of £347,291.

IN BRIEF

IT is announced that Cdr. Sir Robert Micklem, C.B.E., R.N., and Sir James Reid Young, C.A., F.C.I.S., have been appointed joint managing directors of Vickers, Ltd. Sir Robert Micklem is chairman of Vickers-Armstrongs, Ltd., and Sir James Reid Young is director of finance and administration in that company.

* * *

On December 3rd Aviation Traders, Ltd., are due to move into new London headquarters at 15, Great Cumberland Place, W.1 (Ambassador 2091).

* * *

High Duty Alloys, Ltd., announce that the new address of their Northern Area Sales Office is Colwyn Chambers, 24, Mosley Street, Manchester, 2 (Central 2758).

* * *

Aluminium Wire and Cable Co., Ltd., of London, announce the opening of a Midlands office at Great Western Buildings, 6, Livery Street, Birmingham, 3 (Central 5370).

* * *

The British Tyre and Rubber Co., Ltd., announce the appointment of Mr. Percy W. Howard as managing director. He joined the company in 1926 as sales manager.

* * *

A new illustrated brochure on their full range of electronic measuring equipment has been issued by Dawe Instruments, Ltd., 130, Uxbridge Road, Hanwell, London, W.7.

MR. A. W. MILLARD, A.R.Ae.S., who has resigned his position with Bryans Aeroquipment, Ltd., and now goes to W. A. Rollason, Ltd., Croydon Airport. "Mill" joined Cdr. J. R. Bryans on the formation of Rollason Aircraft Instruments and Equipment, Ltd., which subsequently became Bryans Aeroquipment. Originally chief inspector of that company, and, since 1945, research and development engineer, Mr. Millard was responsible for developing their wide range o test equipment.

Arrangements have been made between the Monsanto Chemical Co., St. Louis, Mo., and Esso Export Corporation for worldwide distribution of the former company's "Hydrol" non-inflammable aircraft hydraulic fluid.

* * *

A new flux in the range made by Enthoven and Sons, Ltd., solder specialists, of 89, Upper Thames Street, London, E.C.4, is "Telecene"; it is intended for use in mass-dip soldering processes for electrical and other equipment.

* * *

Describing and illustrating their A.R.B.-approved radio-overhaul and maintenance facilities, an illustrated brochure has been prepared by Aerocontacts, Ltd., Gatwick Airport, Horley, Surrey. Visitors, incidentally, are invited to inspect their new overhaul shop.

* * *

Avro Canada, Ltd., announce the appointment of Mr. William H. Dickie as director of industrial relations. The importance of the post is emphasized by the company's statement that the present labour force of 7,500 engaged on CF-100 and Orenda production is expected to rise to 12,000.

* * *

As from December 1st the head office of the British Aluminium Co., Ltd., will be at Norfolk House, St. James's Square, London, S.W.1 (Whitehall 7868). The company was to have moved there in 1939, but the building was requisitioned; ultimately it housed the S.H.A.E.F. planning staff.

* * *

A new and improved version of their well-known self-contained portable inspection lamp has been produced by Nife Batteries, of Redditch, Worcs. Capable of projecting a long-range, high-candle-power beam, this P.6 lamp was designed primarily for the inspection of overhead power-lines.

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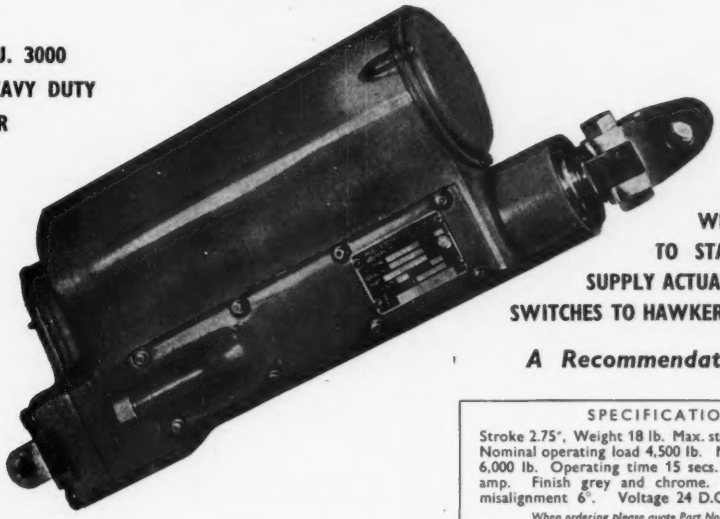

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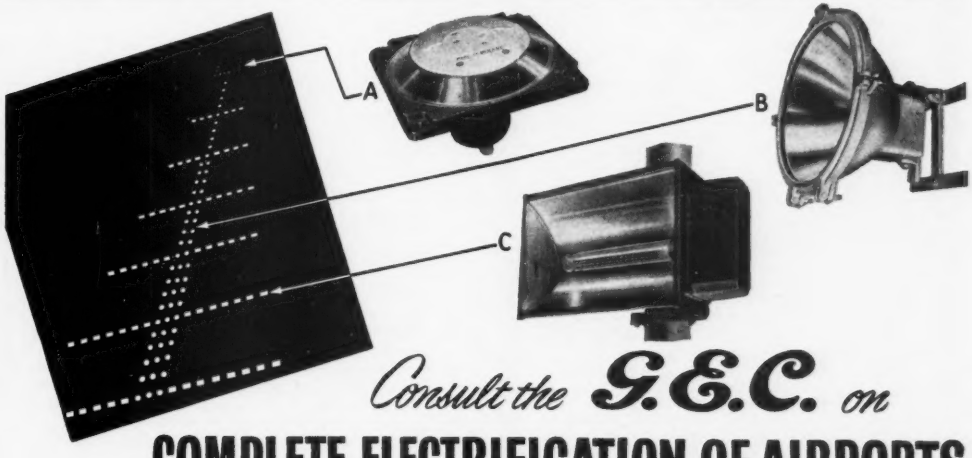

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SAUNDERS VALVE COCKS

By any other name would be as fleet

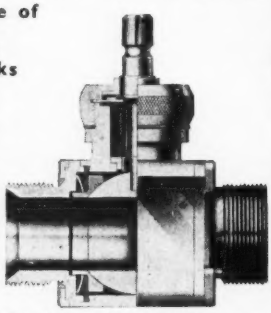
Were it not for the error of assuming finality in our own day it would seem that the superlatives of our present vocabulary are the only sufficient titles for the nameless aircraft now known to us by mere numbers.

By any other name than Hawk or Fury, Hurricane, Typhoon and Tempest would Hawker aircraft have been as fleet and as frightening as, in fact, they were and are.

So long as the dictionary keeps pace with designers and coins new words indicative of speed and aggressiveness all is well, but, if only for the peace of succeeding generations of aircraft constructors, we are tempted to advocate the ending of all nomenclature by naming the 1067—ten, sixty-seven! Hereafter let mere 'dates' suffice; they may at least enable us to polish up our history. Meantime congratulations to the Sopwith Hawker team on a succession of worthy names—and numbers, culminating (we suspect *not*) in the 1067.

Saunders Spherical and Taper Plug Cocks and Non-return Valves are this company's contribution to the current Hawker productions and it is with pride that we grapple with the continually increasing demand.

The scope of Saunders Spherical Plug Cocks



In addition to the screwed end types for standard A.G.S. union fitting, there are clamp joints and flush end models for attachment direct to tanks, assemblies, etc. Amongst the many fluid systems handled by these cocks are fuel, oil, oxygen, nitrogen, vacuum, L.P. hydraulics, de-icing and water injection. For hot air and fluids up to 250° C there is a special metallised version.

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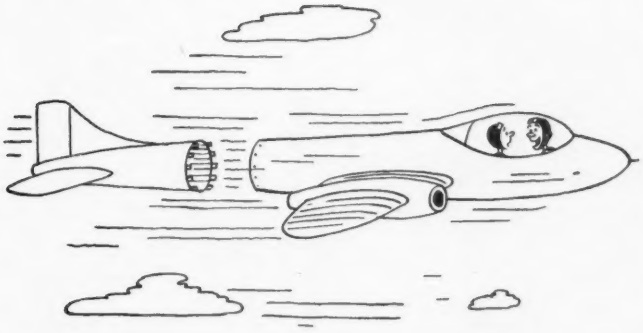

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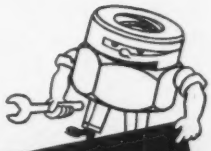

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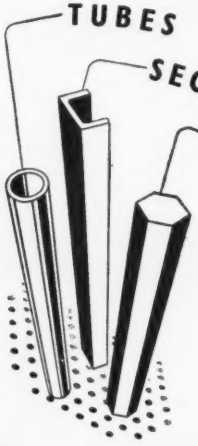

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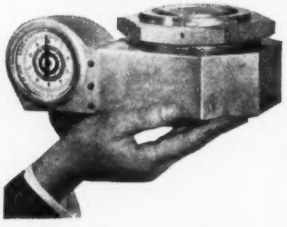

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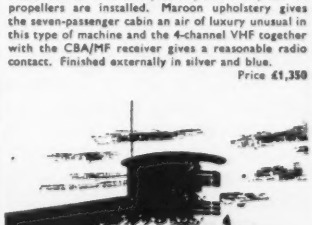

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Post (A) Research work in connection with aircraft flight testing.

Post (B) to lead a team in aeronautical research work connected with the development of flight testing and operating technique for helicopters.

Candidates must possess a 1st or 2nd-class honours degree in mathematics, physics or engineering, or equivalent qualification, and at least three years' post-graduate research experience.

For Post (A) a knowledge of aerodynamics or fluid mechanics is essential and some industrial experience is desirable.

For Post (B) a practical outlook combined with an interest in mathematics is required and experience in aeronautical research is essential. The candidate should have the administrative ability to run a small section.

The Commissioners may, at their discretion, admit a candidate of high professional attainment notwithstanding that he or she may not possess these qualifications.

Candidates must have been born on or before August 1st, 1920, but these posts (and similarly graded scientific posts in other Government Departments) are also open to candidates born between August 2nd, 1920, and August 1st, 1925 (inclusive) through the Open Competition under Normal Regulations already announced (No. 3399).

Salary scale (men) £720 to £910 (women £595 to £810. Posts carry benefits under Federated Superannuation System for Universities.

Further particulars and application forms from the Civil Service Commission, Scientific Branch, Trinidad House, Old Burlington Street, London, W.1, quoting No. S4104/51. Completed application forms must be returned by December 20th, 1951. [7286

ENGINEERS required by Ministry of Supply in London must be British, of British parentage, with regular engineering apprenticeship and either be corporate members of one of the Institutions of Civil, Mechanical or Electrical Engineers, or have exempting qualifications.

Post (I): (Ref. C690/51A). Production planning of chemical and mechanical propulsion units (rocket motors, pulse jet engines, etc.) ancillary equipments (fuel and booster pumps, mixing and pressure valves, igniters, etc.). A knowledge of solid and liquid propellants is required together with experience of sheet metal fabrication.

Post (II): (Ref. C691/51A). Production planning of guidance equipment (electronic, air and ground guidance apparatus; valves, fuses, test gear) and control equipment (mainly gyroscopic and servo-mechanisms) for guided weapons. Candidates should preferably have experience on miniature and sub-miniature equipment, and production in the radio industry.

Salary: Within the range £900-£900 p.a. Unestablished, periodical competitions for established pensionable posts.

Application forms from Ministry of Labour and National Service, Technical and Scientific Register (K), Almack House, 26-28 King Street, London, S.W.1. Quoting appropriate Reference No. [7289

NAVIGATION instructor for No. 10 Reserve Flying School at Exeter Airport. Ex-R.A.F., fully qualified, preferably held staff navigator's grant and in current flying practice.—Apply Managing Director, Exeter Airport, Ltd., Honiton Clyst, Devon. [7293

SCHEDULE clerks required (male) with experience in compiling M.o.S. spares schedules.—Applications, in writing, stating age, experience and salary required, to Personnel Manager, Percival Aircraft, Ltd., The Airport, Luton, Beds. [0596

TECHNICAL authors and illustrators required. Knowledge of M.o.S. procedure desirable.—Applications, in writing, stating age, experience and salary required, to Personnel Manager, Percival Aircraft, Ltd., Luton Airport, Beds. [0594

SENIOR, intermediate and junior mechanical draughtsmen wanted for aircraft work. Previous aircraft experience not essential. Pension and life assurance scheme.—Apply: Employment Manager, Vickers-Armstrongs, Ltd. (Aircraft Section), Weybridge. [6920

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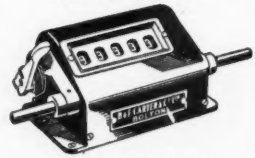

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SENIOR and junior weight engineers required. Interesting work on new projects. Permanent positions offered to suitable applicants.—Apply, stating age, experience, qualifications and salary required, to Chief Designer, Gloster Aircraft Co., Ltd., Witcomb, Glos. [0915

GLOSTER AIRCRAFT Co., Ltd., have vacancies for fully experience aircraft structural and electrical draughtsmen.—Applications, in writing, stating age, experience and salary required, to Employment Officer, Gloster Aircraft Co., Ltd., Hucclecote, Glos. [0910

VACANCIES for draughtsmen and stressmen exist in the Saunders-Roe Helicopter Division at Eastleigh, near Southampton.—Interested persons should write, stating age, experience, qualifications, salary required, etc., to the Personnel Officer, Saunders-Roe, Ltd., East Cowes, Isle of Wight. [7141

ENGLISH ELECTRIC have vacancies in their London Design Office for aircraft stressmen.—Suitably qualified men, having structural stressing experience, should write, giving full details and quoting Ref. 803A, to Central Personnel Services, English Electric Co., Ltd., 24-30, Gillingham Street, London, S.W.1. [7241

DRAUGHTSMEN, senior and junior mechanical engineering draughtsmen urgently required, also a lady tracer. Ring or write Personnel Superintendent at Blackburn and General Aircraft Co., 121, Brough, Ext. 133. The Labour Office is opened an Saturdays. Fares refunded to applicants calling at Brough for interview. [7248

PLANNING engineers (aircraft) required. Considerable production planning experience and sound knowledge of metal airframe components manufacture essential.—Applications in writing to Personnel Manager, Percival Aircraft Ltd., Luton Airport, Beds., stating age, experience and salary required. [7273

DOWTY EQUIPMENT, Ltd., aircraft hydraulic engineers, Arle Court, Cheltenham, require stressmen. The factory is ideally situated and the environment and working conditions are excellent. Pension scheme, five-day week.—Write Personnel Manager, stating age, qualifications and salary expected. [0903

SURREY FLYING SERVICES, Ltd., urgently require aircrew for "York" aircraft, flight navigators. Radio officers must be in possession of current licences. Corporation rates of pay.—Apply by letter or 'phone, Surrey Flying Services, Ltd., 18 Buckingham Gate, S.W.1. Tel.: Whitehall 0055. [0951

TECHNICAL writers required for interesting work compiling overhaul and maintenance manuals for gas-turbine aero engine manufacturer in Coventry. Good prospects. Pension scheme.—Applications in writing, stating age, experience and present salary, to ref. TW.1, Box 5397. [7304

DESIGNER draughtsman with comprehensive experience in light engineering. Knowledge of hydraulics an advantage. Good prospects. Salary according to qualifications. South Midlands area. Assistance given with accommodation. State age, salary and experience.—Box 5371. [7280

SENIOR licensed aircraft engineer required by Cambrian Air Services, Ltd., Cardiff Airport, operating Scheduled services Liverpool-Cardiff-Channel Islands. "A" and "C" licences on Rapide. Proctor, Auster, essential. Salary according to qualifications and ability. Good prospects for experienced engineer.—Apply: Chief Engineer. [7303

APPLICATIONS are invited by the Ministry of Supply from physicists and electrical engineers for appointments in the experimental officer class within the following fields of work in the Instrument and Photographic Department of the Royal Aircraft Establishment, Farnborough, Hants.

(1) Development work on analogue computors and servo-mechanisms. Candidates must be willing to fly as an observer.

(2) Development of automatic pilots and associated equipment. This work involves tests in the laboratory and in the air so that candidates should be willing and fit to fly in modern high-speed and high-altitude aircraft.

(3) For research and development work in connection with gyroscopic and allied instruments. The minimum qualification is Higher School Certificate with Physics and Mathematics as principal subjects, but other qualifications, such as Higher National Certificate in Engineering or a Degree in Physics would be an advantage for some of the posts.

For all posts a sound basic knowledge of physics or engineering is essential, with a bias towards light electromechanical or electronic engineering. Salary will be assessed according to age, qualifications and experience within the following ranges: experimental officer (minimum age 28) £545-£895. Assistant experimental officer £240 (at age 18) to £505. Rates for women somewhat lower. Posts are unestablished.—Application forms obtainable from Ministry of Labour and National Service, Technical and Scientific Register (K), Almack House, 26-28, King Street, London, S.W.1., quoting A.362/51/A. [7307

APPLICATIONS are invited from senior and intermediate design draughtsmen; experience of aero engine design, desirable but not essential.—Please write stating age and giving details of previous experience in chronological order to the Personnel Officer, The de Havilland Engine Co., Ltd., Stag Lane, Edgware, Middlesex. [0449

ONE male test laboratory assistant required. National Certificate standard and preferably 2-3 years' experience on design and analysis of mechanical tests.—Applications in writing, stating age, experience and salary required, to Personnel Manager, Percival Aircraft, Ltd., The Airport, Luton, Beds. [0597

H. M. HOBSON, Ltd., invite applications for positions in the drawing office as follows: designers, detail and modification draughtsmen, checkers, stressmen. The work is concerned with interesting projects connected with fuel metering equipment and hydraulic flying controls for aircraft.—Hobson Works, Fordhouse, Wolverhampton. [0620

DRAUGHTSMEN. Design, detail and checkers required for work on gas turbine fuel systems. Experience in light hydraulics an advantage but not essential. Good salary, excellent conditions. Pension scheme.—Apply: Joseph Lucas (Gas Turbine Equipment), Ltd., Shaftmoor Lane, Hall Green, Birmingham. [7233

STRESSMAN—section leader required for work on new projects. Fuselage stressing experience desired. Assistance in finding initial accommodation. Applications, stating age, salary required and details of experience and qualifications, to Personnel Manager, Boulton Paul Aircraft, Ltd., Wolverhampton. [7231

SENIOR and junior technical assistants are required for experimental and development work on aircraft propulsion units. Candidates should have an engineering degree or its equivalent. Previous experience of this type of work is desirable but not essential.—Reply, giving details of qualifications and experience, to Ref. S.A.J., Armstrong Siddeley Motors, Coventry. [7314

INTERNATIONAL AERADIO, Ltd., require experienced air traffic control officers for duty abroad. Continuous contract, free passages, home leave every 2-3 years, local leave annually, pensionable posts. Free quarters provided, or allowance in lieu, kit allowance. Minimum income about £700 p.a.—Apply, quoting ATC(2) Senior Admin. Officer, 60, Park Street, London, W.1. [7309

SITUATIONS VACANT

IMPORTANT Midlands aircraft engine manufacturer has vacancies for a number of designers and senior and junior draughtsmen. The work is connected with gas turbine engines. Although experience is most advantageous it is not necessarily essential as training will be given. —Apply in some detail please to Armstrong Siddeley Motors, Ltd., Reference 101, Coventry. [0616

SKILLED inspectors required for standards room and metrology work. Applicants should have had experience in the checking of gauges and tools, and fine measurement generally. A knowledge of mathematics to School Certificate or National Certificate standard is desirable.—Apply: The Personnel Officer, The de Havilland Engine Co., Ltd., Stonegrove, Edgware, Middlesex. [732)

MANUFACTURERS of aircraft undercarriages and hydraulic equipment in North-West invite applications to fill vacancies for stressmen. Graduates with previous stressing experience preferred, but not essential. Good working conditions. Salary dependent upon qualifications, ability and experience.—Write, giving full details to Box 5398. [7308

SENIOR technical assistants required for engine technical office. Knowledge of engine stress calculations and mechanical testing, including vibration analysis desirable. B.Sc. and/or A.M.I.Mech.E. preferred.—Write, giving age, previous experience and qualifications in chronological order to The Personnel Officer, The de Havilland Engine Co., Ltd., Stag Lane, Edgware, Middlesex. [7284

APPLICATIONS are invited for the following positions in the London area: Draughtsmen required for detail drawing of experimental designs of aircraft electrical equipment. Works experience essential.—Write, giving full details in strictest confidence to the Employment Officer, Rotax, Ltd., Chandos Road, Willesden Junction, N.W.10. [7271

ILFORD, Ltd., require architectural assistants capable of work up to Intermediate standard R.I.B.A., and experienced in industrial construction work. Five-day working week with pension scheme in operation. Canteen in operation. Applications in writing, giving age, training and experience to Chief Staff Architect, Ilford, Ltd., Romford, Essex. [7311

CAMBRIAN AIR SERVICES, Ltd., of Cardiff, require general manager. The position will be mainly administrative but flying duties may be necessary at peak periods. Applications, giving details of flying qualifications, administrative experience and salary required should be addressed to the Secretary at Collingdon Road, Cardiff. [7312

THE GLOSTER AIRCRAFT Co. requires senior and intermediate stressmen to work on designs and projects of advanced interest. Excellent prospects of advancement for sound and energetic men.—Apply, in the first instance, giving full particulars of technical qualifications, age, experience and salary required, to The Chief Designer, Gloster Aircraft Co., Ltd., Hucclecote, Glos. [0914

ARMSTRONG SIDDELEY MOTORS have vacancies in their Coventry factory for senior and intermediate jig and tool draughtsmen to work on both the gas turbine aero engine and car production. This is work of national importance and the right men will be suitably rewarded. —Please reply in some detail, to Reference JTD, Armstrong Siddeley Motors, Ltd., Coventry. [7235

AIR FORCE, Naval, civil and helicopter aircraft all under design and development at Percival Aircraft, Ltd. Applications are invited from senior and junior draughtsmen, and stressmen, for work on this interesting programme.—Write, giving details of experience and salary required, to Personnel Manager, Percival Aircraft, Ltd., Luton Airport, Luton, Beds. [0595

FLIGHT test observers and aerodynamicists, capable of performance reduction and analysis and preparation of reports, required for programme of civil and Service aircraft development. Good prospects for keen workers.—Apply, giving full particulars of training, experience, age and salary required, to Personnel Manager, Percival Aircraft, Ltd., The Airport, Luton, Beds. [0572

PLANNING engineers urgently required. Must be thoroughly experienced in planning and processing of light engineering and aircraft components, including sheet metal work, detail fitting shop and press shop. Good opportunities and pleasant working conditions.—Apply, giving full details of previous positions and experience, to Personnel Manager, Scottish Aviation Ltd., Prestwick Airport, Ayrshire. [7227

TECHNICAL assistants, both junior and senior, required in mechanical engineering department for work of national importance in connection with development of gas turbine engines. Excellent prospects exist in sections dealing with rig test of engine components, vibration, static structure test and research in gears and bearings. Qualifications: degree or H.N.C.—Apply: Reference No. VI, Armstrong Siddeley Motors, Ltd., Coventry. [0952

INSTALLATIONS Supervisor required. Applications are invited from men with experience of maintenance and test of small electronic and electro-mechanical devices. Additional mechanical knowledge an advantage. Qualifications: H.N.C. standard.—Write, stating age, experience and salary required, to Personnel Manager, Sperry Gyroscope Co., Ltd., Great West Road, Brentford, Middlesex. [7256

LANCASHIRE AIRCRAFT CORPORATION invite applications for planner/ratefixers at Bovingdon and Blackpool, in the following sections: engines, electrical, airframe, instrument, radio. National Joint Industrial Council rates of pay and conditions of employment.—Apply to Personnel Manager, Lancashire Aircraft Corporation, Bovingdon Airport, near Hemel Hempstead, Herts. [7301

THE DE HAVILLAND AIRCRAFT Co., Ltd., have a few vacancies in the aerodynamics department, which covers a wide range of technical work. Applicants with engineering degree preferred, but sound technical training essential.—Write, stating age, qualifications, experience and salary required, to the Chief of Aerodynamics Department, de Havilland Aircraft Co., Ltd., Hatfield, Herts. [7305

AIRCRAFT draughtsmen are required by the English Electric Co., Ltd., for employment at Warton and Acton, London. Men with good aircraft structure or jet engine installation and fuel system experience should write, giving full details of their qualifications and experience, quoting Ref. 210G Central Personnel Services, English Electric Co., Ltd., 24-30, Gillingham Street, London, S.W.1. [7276

CHRISTCHURCH, The de Havilland Aircraft Co., Ltd., Airspeed Division, invites applications from experienced senior and intermediate stressmen for vacancies in an expanding stress office at Christchurch.—Applicants preferably should have had experience in design stressing of high-speed aircraft from the project stage onwards. —Apply to Personnel Manager, The de Havilland Aircraft Co., Ltd., Airspeed Division, Christchurch, Hampshire. [7299

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D. NAPIER AND SON, Ltd., have vacancies for young technical assistants for analysis of experimental engine test results and performance work in connection with the development of high-speed I.C. engines. Applicants with at least O.N.C. and preferably with experience of similar work should write stating age, experience, qualifications and salary, quoting ref. 455, to Central Personnel Services, English Electric Co., Ltd., 24-30, Gillingham Street, London, S.W.1. [7252

SENIOR technical assistants required for the service department of the De Havilland Engine Co., Ltd., preferably with experience on reciprocating and gas turbine engines. Suitable applicants will be required to work on the H.Q.'s staff of the Service Department at Leavesden Aerodrome, near Watford, Herts. — Apply in writing, stating age, qualifications and salary required, to The Personnel Officer, The de Havilland Engine Co., Ltd., Leavesden, near Watford, Herts. [7294

AN instrument mechanic is required for duties in the electronics section of the research and experimental department. Applicants should possess a high degree of mechanical skill, and be able to participate intelligently in both design and manufacture of small electro-mechanical devices. Experience in a similar capacity, whilst desirable, is not essential.—Write, stating age, experience, and salary expected to the Personnel Officer, Saunders-Roe, Ltd., East Cowes, I.O.W. [7265

APPLICATIONS are invited for the following positions in the London area:—Development engineers required by manufacturers of a.c. and d.c. electrical equipment for aircraft. Applicants should hold at least a Higher National Certificate or preferably an Engineering Degree. The positions are superannuated and give considerable scope to men with adequate experience.—Write, giving full details in strictest confidence, to the Employment Officer, Rotax, Ltd., Chandos Road, Willesden Junction, N.W.10. [7270

THE GLOSTER AIRCRAFT Co. requires the services of a number of aerodynamicists, (a) for design and project work, and (b) for flight test reduction. Opportunity exists for individuals to vary their experience within the Aerodynamics Department. Candidates with some years' experience preferred, but applications from juniors with sound mathematical ability will receive full consideration. —Apply, in the first instance, giving full particulars of age, experience and salary required, to The Chief Designer, Gloster Aircraft Co., Ltd., Hucclecote, Glos. [0913

FIELD trials assistants. Applications invited, interesting appointments connected with trials of new project. Successful applicants required to travel (London and West Wales). Experience in small electronic, electro-mechanical or hydraulic devices necessary. General experience in the field essential. Ex-Service artificer grades with suitable experience would be considered.—Write, stating age, experience and salary required, to the Personnel Manager, Sperry Gyroscope Co., Ltd., Great West Road, Brentford, Middlesex. [7257

TECHNICAL assistant required to undertake technical and administrative duties. An orderly mind and ability to write concise reports are essential. A degree or Higher National Certificate and general experience of aircraft engineering are desirable but opportunity exists for man with practical outlook and limited aircraft experience to extend his knowledge of aircraft design.—Applications should be made to the Chief Draughtsman, The English Electric Co., Ltd., Aircraft Division, Warton Aerodrome near Preston. [7234

THE NEW ZEALAND NATIONAL AIRWAYS CORPORATION require engine and airframe fitters, electricians, instrument mechanics and radio mechanics for service in New Zealand. Applicants must have good experience in the aircraft industry on modern aircraft and equipment. Only single men wishing to emigrate to New Zealand should apply. Free passage provided, accommodation arranged on arrival.—Applications, giving full details of training, experience and qualifications, should be sent to Chief Personnel Officer, B.O.A.C., Airways House, Great West Road, Brentford, Middx. [7322

D. NAPIER & SON, Ltd., Liverpool, require senior and junior jig and tool draughtsmen for interesting new engine project. Men with experience of aero, automobile or diesel engine production tooling are preferred but this is not absolutely essential. Good salary and prospects. Modern factory, staff pension scheme in operation after qualifying period. Every assistance will be given to obtain accommodation. Sports and social facilities cover a wide range. Write, stating age, experience and present occupation quoting Ref. 125B to Central Personnel Services, English Electric Co., Ltd., 24-30 Gillingham Street, London, S.W.1. [7317

BRITISH EUROPEAN AIRWAYS have vacancies at Northolt for two technical instructors. Candidates with wide knowledge of M.C.A. and A.R.B. requirements. Must have served recognised engineering apprenticeship or equivalent; have had experience as technical instructors in aeronautics; possess general knowledge of several types of aircraft and a sound knowledge of aircraft electrical installations. A, C and X Licences on multi-engine aircraft are desirable. Salary scale £345 per annum to £695 per annum.—Apply, in writing, to Personnel Officer, Flight Operations Dept., B.E.A., Keyline House, Russell, Middx. [7314

BRITISH OVERSEAS AIRWAYS CORPORATION invite applications for the position of engineering instructor (electrical and instruments) to be stationed near London Airport. The duties include instruction on electrics, instruments and auto-pilots to pilots, flight engineers, and engineering personnel. Applicants must have technical knowledge to "C" licence standard; ability for clear self-expression and for writing training manuals, lecture notes etc. At least five years' practical aircraft maintenance and overhaul experience is necessary. Salary £345 to £695 p.a., according to qualifications and experience.—Applications, in writing, to Chief Personnel Officer, B.O.A.C., Airways House, Great West Road, Brentford, Middx. [7305

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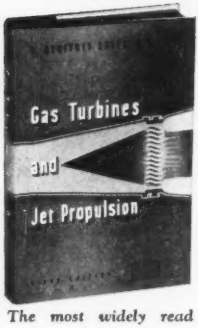

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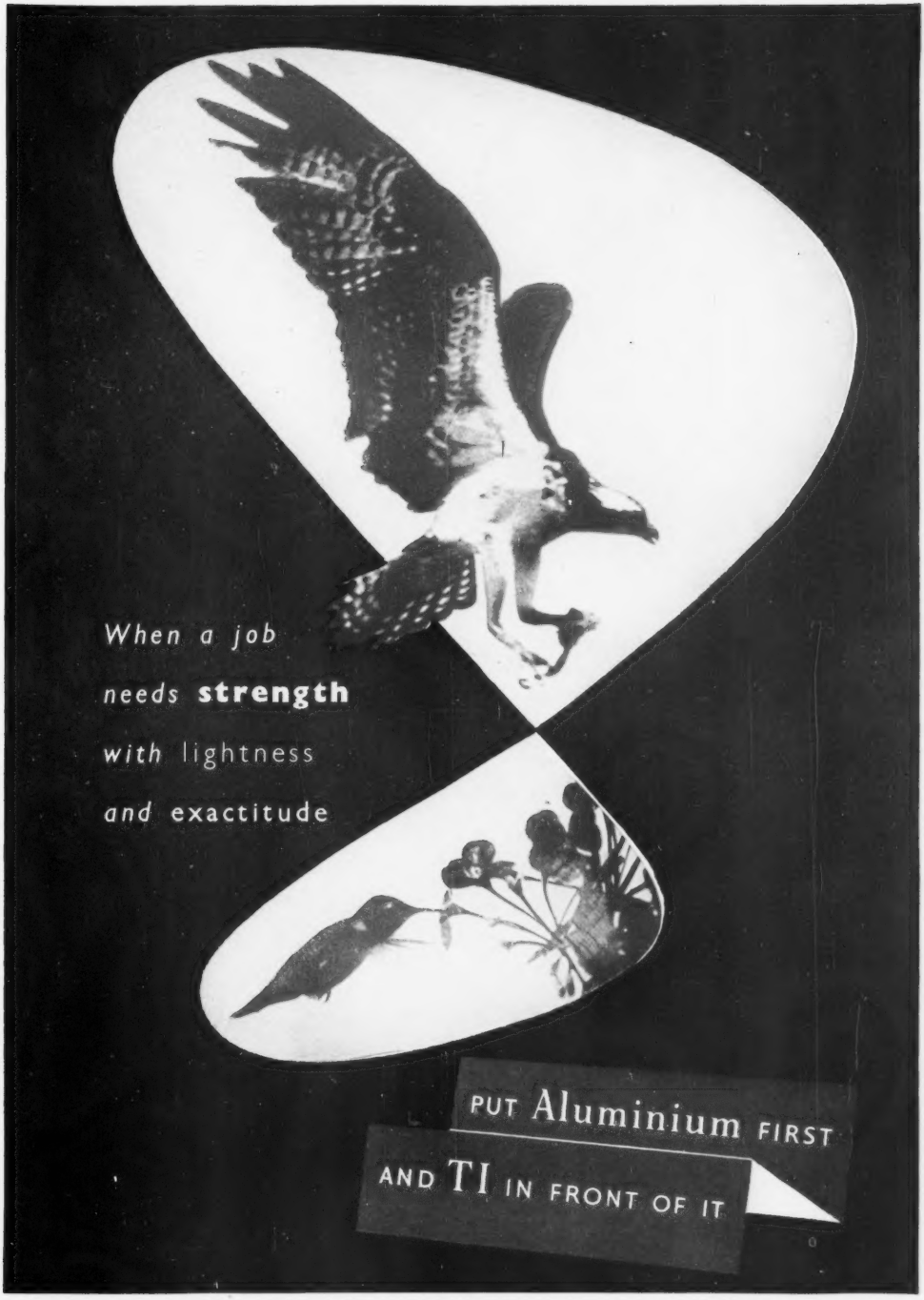

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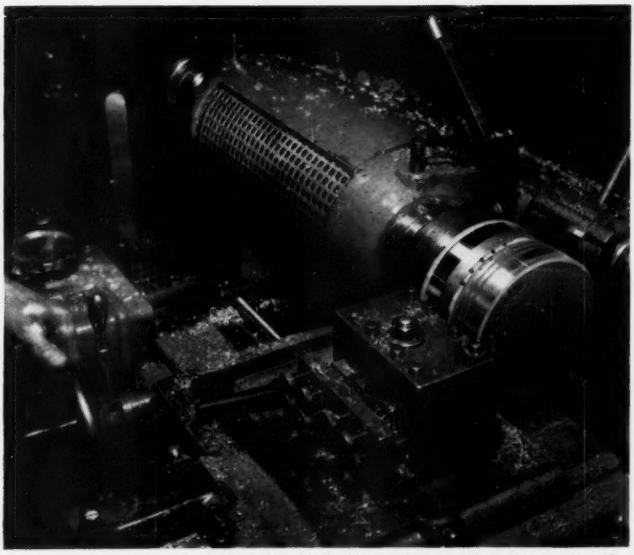
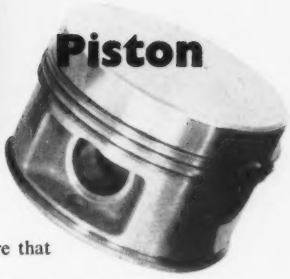
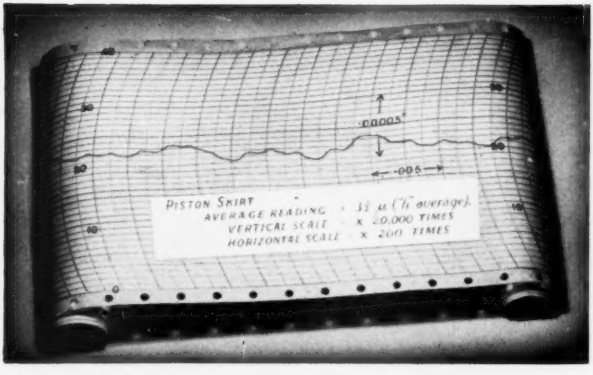


Diamond Turning the skirt of a Piston for a "Bristol" sleeve-valve engine.

Machine finishing a Piston



The high finish on "Bristol" pistons is obtained by the use of a diamond cutting edge combined with a high cutting speed and slow feed. To ensure that the desired quality of finish is maintained, tests are regularly made on a "Talysurf" surface measuring machine, which gives a highly magnified reproduction on a paper chart of the surface under test. The surface finish is then measured as the average amplitude of the resulting curve above and below a mean line, a typical value for the piston skirt being six micro-inches. The piston skirt is one of many applications of diamond turning in "Bristol" workshops.



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